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BRITISH DAIRY-FARMING.

BRITISH
DAIRY-FARMING

TO WHICH IS ADDED A DESCRIPTION OF

THE CHIEF CONTINENTAL SYSTEMS

BY

JAMES LONG

(MERLIN, OF "THE FIELD.")

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THIS WORK IS, BY PERMISSION OF HIS GRACE,

Dedicated to

THE DUKE OF WESTMINSTER,

WHO,

WITH LORD VERNON AND LORD TOLLEMACHE,

HAS SET AN EXAMPLE TO THE GREAT LANDLORDS OF ENGLAND WHICH IS BEYOND ALL PRAISE.

The Dedication of Books is a fashion which I have never appreciated; but in this instance it permits me to testify my humble admiration of the largeness of heart, as well as the public spirit, which has induced His Grace to evince such a substantial interest in Dairy-Farming.

PREFACE.

It is an old custom, especially among authors of works upon technical subjects, to introduce their books with an apology. I have not written this book because there is no other in the market, nor because I felt specially called upon to supply a demand. Every person who is connected with agriculture must have noticed that a great Dairying movement has commenced, and recognising its importance I, some two years ago, commenced this work. My object has been to produce a plain and practical handbook, composed of facts and details resulting as far as possible from personal experience, and such as will enable the farmer to master the primary intricacies of milk and its various products. I have not been content to deal with British Dairying alone, but have devoted a considerable number of pages to Dairy work on the Continent, believing that we have much to learn from those people of other nations who have made milk manipulation their study and practice, and that we shall in the future adopt some of their systems with great pecuniary profit. It is possible that some of the opinions I have expressed may not meet with general approval, inasmuch as they are sometimes contrary to conventional teaching; but some hundreds of experiments have shown me that the old lines are often unsound, and sometimes indeed absolutely devoid of truth.

Some of the material included in this work originally appeared in the columns of the *Field*, and I owe my best thanks to the proprietors of that journal for permission to reproduce it. It was perhaps as much owing to the favour with which these articles, and others contributed to the agricultural press, were received as to anything else that I have been induced to complete the present volume. I also owe my acknowledgments to Mr. H. M. Jenkins, F.G.S., Secretary of the Royal Agricultural Society of England, whose extended knowledge and well balanced judgment are deserving of the highest appreciation, and who has very kindly given me the advantage of both;* to my friends, Professor Segelcke, of Copenhagen; Monsieur Eugène Chesnel, Editor of *L'Industrie Laitière*, Paris; Monsieur Cottu; Herr Schatzmann, director of the Station Laitière, Lausanne; and also to M. Pouriau, (author of "La Laiterie," to which I am much indebted), Professors Morière, Arnold, Alvord, and Fjord, all of whom have contributed to the welfare of dairy-farmers throughout the civilised portion of the universe.

I have scarcely referred to American Dairying, for I conclude that it is not yet identified with British demands. Nor is it necessary to treat of its higher branches in a work of this practical nature; the student and the scientist in their researches will naturally turn to American works, or to the able and ponderous volume of Professor Sheldon. It is rather to France, to Switzerland, to Denmark, and to Holland that I have devoted my attention; and what I have seen in these countries has confirmed my opinion that we may follow them in many respects with advantage. My reference to Germany chiefly relates to its factory work; for several visits to that country have failed to convince me that there is any system which, common amongst

* I may here remark that there is probably no man in England who has done so much for Dairying as Mr. Jenkins, who, setting aside his official position, would ere this have been publicly rewarded in any other country but England.

farmers, is worthy of recommendation to English readers. My views may be wrong, but what is written is written, as much in the hope of being useful to my own countrymen as profitable to myself. If the book meets with one-half the kind words that were accorded to "Farming in a Small Way," not only from the agricultural press, but from the *Saturday Review*, the *Spectator*, and other journals of a like critical nature, I shall be gratified. If it does not, and I have no right to expect that it will, it will still live, because it is composed of facts and truths, and I shall still write, because, while most sensitive to public appreciation, I owe every successful line I have written in the past to wholesome, and sometimes severe criticism.

GRAVELEY MANOR,
NEAR STEVENAGE.
April, 1885.

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BRITISH DAIRY-FARMING.

CHAPTER I.

INTRODUCTION.

PERHAPS at no time in the history of British agriculture has so much attention been directed to that branch of it, viz., dairy-farming, as during the last four or five years. Unfavourable seasons, the increased burdens upon occupiers of land, the insecurity of land tenure and of tenants' investments, and finally the competition from abroad, have taught farmers to inquire whether there are not other sources of revenue to be derived from the soil than the growing of corn, beef, and mutton. If, it is argued, we cannot compete with America in the price of wheat or beef, and if an unfavourable season—and it is at all times uncertain—brings us scanty crops, such indeed as will not enable us to pay our way, why should we not endeavour to produce milk for the consumption of our townspeople, and compete with other countries, as we can do if we try, in the manufacture of cheese and butter?

England imports largely of all the products of the soil which her own farmers grow at home, and it is only natural to assume that they should produce that commodity which entails upon them the least prospect of loss, or doubt as to its ready and profitable

sale. It cannot be denied that, although both corn and beef are often, very often, grown at a loss, yet milk, cheese, and butter almost always fetch remunerative prices; and that although the first-named foods are continually in demand, there is always a fair, and generally a good, supply; yet in many parts of the country milk often cannot be obtained, fresh butter is comparatively unknown during several months in the year, and the best English cheeses are not to be procured at all. Not only is this the case, but inferior articles are largely imported and sold throughout every one of our great centres of population at prices which would amply repay the English producer.

It is a strange yet significant fact that for many years our leading agricultural societies have strained every nerve, devoted large sums of money and plenty of energy, and availed themselves of the best ability of which the country can boast, to introduce and perfect machinery, to encourage the manufacture of artificial manures, and to improve the various native breeds of cattle for the butcher; but they have scarcely given a passing thought to the milking cow or the manufacture of cheese and butter. Now, however, all this is changed; apathy is converted into energy, dairy-farmers' associations have been formed, demonstrations are conducted by the leading agricultural societies, and men of practical knowledge are continually guiding the public mind, and telling some truths about the dairy which were before unknown. The rage in other countries is greater than it is here. In America factories are common, and the glories of the milk-and-butter cow are almost eclipsing those of the fashionable Shorthorn. Sweden, Denmark, and Germany are on the *qui vive*, and machines which they have sent us have already excited the admiration of our teeming population; but while we have opened our eyes to the magnitude of the business in dairy produce which we are conducting with other nations, we are still importing. In 1879 we imported above 2,000,000 cwts. of butter, of the value of £10,250,000, or 50 per cent. more than it was ten years previous. In the same

year we received from abroad nearly 2,000,000 cwts. of cheese, of the value of nearly £4,000,000; whereas, if we come to 1883, we find that our imports of butter had risen to 2,332,701 cwts., while cheese exhibited a further if only slight increase; France, Denmark, Holland, and Belgium all showing increases in 1882 in butter exports, although America has fallen off considerably both in her exportation of butter and cheese. These figures, if rightly weighed, must prove startling to any reader who is alive to the ability and resources of our farmers, and he will immediately ask the question why so much money should be sent abroad for foods which could be much better produced at home. Our great Shorthorn "fanciers" —we must call them so—have something to do with the matter, for they have, although with a good object, directed the attention of farmers and stock-breeders to pedigree and beef—in fact, to every point but milk; and what is the result? Beef has been landed in England much cheaper than it can be grown here; and as for the effect upon the dairy, Mr. Colman, in his evidence before the Committee in the House of Commons, declared that milch cows in Derbyshire did not produce what they did twenty years ago. If agricultural reformers were as constant and energetic for a few years in bringing to the front races of animals suitable for the dairy as they have been in producing and worshipping the Shorthorn, the time would not be far distant when the production of dairy foods would be trebled in this country. With regard to "systems," England need desire no method of butter-making better than her own, but Eastern nations can tell us how to pack and keep butter. We are able to manufacture numerous cheeses, which are admired wherever our produce is known; but our wealthier classes are large consumers of tasty Continental varieties, hence a practical knowledge of the systems by which they are made will be valuable to those who are far-sighted enough to see how well they will pay, and who know what an enormous quantity is sold in London and other large centres.

There is another subject which has a marked influence upon

the home production of cheese and butter—it is the diminution of our dairy cattle. The number of cows in calf and in milk is considerably less than in 1876 and 1877, and although there was a decided increase during the past year, it is by no means equal to the demand for butter, without any regard to cheese. In his opening lecture at the new Agricultural College, Mr. Sheldon said:

"It is computed that the dairy cows of these islands each yield on the average about 440 gallons of milk per annum, and this is making due allowance for inferior milkers and for stirks and heifers, whose yield of milk is generally smaller than that of full matured cows. Now, if we base our estimate on a minimum number of 3,700,000 cows in milk—and this is making a due allowance for deaths and abortive milkers—we have an annual production of 1,628,000,000 gallons, which, valued at *7d.* a gallon, is worth £47,000,000 a year. I assess the milk production of the country at this price, because it is probably the extent of what it realises to the farmer. But in any case the interests involved in dairy-farming in this country are enormous, even if we confine our estimate to milk production alone; and if we include the other interest—such as the sale of surplus stock—we may conclude that the annual income to British agriculture from dairy-farming is not much less than that which flows into the coffers of the Chancellor of the Exchequer. The present value of the bovine stock of these islands may be set down as upwards of £120,000,000. Farmers' capital employed in bucolic agriculture may be assessed at £150,000,000 in the aggregate, and landlords' capital at £900,000,000, making a total of upwards of £1,000,000,000 of capital embarked directly or indirectly in dairy-farming in these little specks in the ocean. Twelve months ago there were in these islands 3,736,403 cows and heifers in calf or in milk; 2,249,881 of cattle 2 years of age and above; and 3,975,252 under 2 years of age; making an aggregate of 9,961,563. These, we say, we value at £120,000,000. Eighteen

months ago there were in the United States of America, 11,826,400 milch cows, valued at $256,953,928; and 21,408,100 oxen and other cattle, valued at $329,543,327; together 33,234,500 head, valued at $586,497,255, or £122,186,928. So that although there are upwards of three times as many bovine stock in America as there are in Great Britain, their value in the aggregate very little exceeds the value of the stock in this country. Such is the influence that markets have on the value of stock. Of the 1,628,000,000 gallons of milk presumably produced in a year in this country, it is probable that about one-eighth is used in the rearing and fattening of calves, leaving a balance of 1,424,500,000 gallons available for consumption by ourselves in the forms of milk, butter, and cheese, including what is used in cooking and what is wasted. If this balance were all made into cheese, it would produce over 500,000 tons of ripe cheese, assuming that a little over 1 gallon of milk is required to make 1 lb. of green cheese, and that cheese loses 15 per cent. of its weight in ripening. The quantity of cheese here mentioned would provide our people with a trifle under 10 ozs. per head per week. If the balance were made into butter, it would produce 230,000 tons, reckoning 22 pints of milk to 1 lb. of butter; and this quantity would provide nearly 5 ozs. per head per week of butter to our people. It is, however, probable that each man, woman, and child in these islands consumes on the average, as milk and in cookeries, one-third of a pint per day, or 15 gallons per year. This mode of consumption disposes of 525,000,000 gallons, leaving 900,000,000 gallons or so to be made into cheese and butter. Of this second balance it is probable that 350,000,000 gallons are devoted to cheese and 550,000,000 to butter. In this event, we produce some 126,000 tons of ripe cheese and 29,285 tons of butter per annum. From America and Canada we import about 70,000 tons of cheese per annum, and from other sources about 30,000 tons, which together amount to about four-fifths of our home production. Of butter we import about as

much as we produce. Here, then, is an opening for dairy-farming—to produce more and import less!"

Having shown how vast is the consumption of foreign dairy produce, and pointed out the advantages which our own farmers should be able to derive from a more extensive connection with dairy industry, let us impress upon them that, much as the English people desire quantity in home-grown food, quality is the chief attribute to which they should direct their attention. The lack of quality in butter has been the chief cause of the appearance of its tasty imitation, for consumers, and especially those of the lower classes, prefer this to what may be termed pure seconds. Inferior butter and cheese cannot be systematically sent into the market at a remunerative price, but imitations agreeable to the palate are largely consumed, and have in consequence seriously interfered with legitimate dairy industry, and they will continue to do so until producers have entered more heartily into the improved systems of manufacture of the genuine article which are being continually explained to them. The farmer and dairyman can be assisted in many ways by science, but it is of no use to help the man who will not help himself. He has a great deal to learn which he is slow to approach; he must reform his method of handling the milk from its leaving the cow to its despatch from the farm; and it is no exaggeration to say that to-day, nine milk-producers out of ten pursue the system of their forefathers without the least intention of changing it; and indeed for them inventions and improvements are made in vain. Their milkers still dip their fingers in the pail; they still use the open pans in damp dairies with brick floors; they churn at any temperature; and handle the butter and make it up without any regard to the quantity of buttermilk still remaining in it. Every man should do his best to remedy this, and each one has it in his power to do something. The subject of the production of food is an enticing one; and when an individual reflects that by his influence, or his knowledge, he may be able to assist in the

prosperity of some of his fellow men and the genèral welfare of his country, although perhaps in a small way, he must be selfish indeed if he does not throw that influence into the great national scale, and accept in return the pleasurable satisfaction of having done good work in his day and generation.

CHAPTER II.

OUR DAIRY SYSTEM.

Of late years very much more attention has been devoted to dairy matters than the subject had received during the previous quarter of a century, and yet, notwithstanding the fact that many who are interested in the business have advanced in some way or attempted some improvement, we are still far from the position of excellence which we ought long ago to have reached. The first great cause of the inefficiency of British dairying is the want of cow stock. A great Parisian dealer once told us that in France a cow was a cow, and he could not induce the French to purchase either Jerseys or Shorthorns. Their great idea is, he continued, to get hold of cheap cows, without taking into consideration the quantity or quality of the milk they yield. This cannot be said of British cow-keepers—at all events with the same force; for the most enlightened have taken up breeding and selection for some time, while even the middle-class farmer at least prefers the use of a Shorthorn bull, when service is required.

A fairly conclusive argument is that showing the number of milch cows kept in Great Britain and Ireland, as follows:

1883.	England and Wales.	Scotland.	Ireland.	Total.
In milk or in calf ...	1,910,900	395,182	1,401,672	3,724,528

or 70,000 more than in 1880.

Compared with other countries how do these figures stand?

Countries.	Acreage.	Population.	Cows.
Belgium	5,520,000	—	750,000
Denmark	6,830,000	1,980,000	1,000,000
Holland	4,973,000	—	1,003,000
Norway	2,800,000	—	741,000
Sweden	11,680,000	4,550,000	1,871,000
Germany	64,549,000	—	8,961,000 [In 1873.
France	90,055,000	—	7,271,000
Italy	27,416,000	—	2,864,000
United States ...	—	—	13,125,000

While we have only 1 cow to 12 cultivated acres, Norway has 1 to 4, Sweden 1 to 6, Denmark 1 to 6¾, Germany 1 to 7, although she has nearly twice as many cultivated acres as we have; Holland has nearly one to every 5 acres, Belgium 1 to between 7 and 8, while even France, the land of the vine, is about equal to ourselves, and Switzerland, with which I am still better acquainted, has its dairy cattle swarming on every cultivated patch of land, and much that is not cultivated.

In some parts of England, it is true, dairying is an important business; but, omitting special districts, and taking an agricultural parish at random, what do we find? The largest occupier, holding 800 acres, keeps 10 Shorthorns. He makes butter for market, and gives his pigs the skim-milk—which same milk, obtained by the Separator or the Cooley system, would prove most acceptable in the nearest town, or even in his own village; for the cottagers seldom see milk in any form. The dairy is conducted as it was forty years ago; the calves are sold directly they are born, and the cows bought in and sold after their fifth calf. With this single exception, there is not a real dairy in a parish of 20,000 acres. The smaller farmers each keep one or two cows of an inferior sort, and a gentleman keeps a fancy herd, but uses most of his milk in fatting calves. And so it is in parishes round about. One or two farmers of good position keep a dairy, but no more;

and the production is, therefore, considerably less than the consumption. Throughout this large agricultural district, then, the vast majority of the population is dependent upon Irish and foreign butter. Our principal dairying counties are Cheshire, with its 94,000 cows, or 1 to every 6 cultivated acres; Derbyshire, with 65,000, or 1 to 8 acres; Somerset, with close upon 100,000, or nearly 1 to 8½ acres; Stafford, with 65,000, or 1 in 9 acres; and Lancashire, with 122,000, or 1 in 6½ acres; Cornwall, with 58,000; Devon, with 86,000; Dorset, with 50,000; Leicester, with 36,000; and Salop, with 54,000, coming next. Jersey, with its 20,000 acres, has 6,200 cows, a higher percentage than any county in England. In some counties cheese is made, and when a certain price can be commanded, nothing can be said; but it so happens that directly this price falls, the producer can make his milk pay him better. The cheese-maker, then, depends solely upon the maintenance of a high figure for his produce; and yet the consuming public justly complains that good cheese is dear. Should foreign cheese excel our own makes—and at present the great bulk of the American is inferior—it follows that British cheese-making may some day decline. That the trade in fancy soft cheeses, which has of late years grown so rapidly. is not taken up by British dairymen is surprising. The profits on the Bondon and the Neufchâtel are considerable; while the public has been told with authority that the makers of Camembert always expect to realise £35 per cow per annum. That special cheeses cannot yet be made here as perfectly as in their native districts may be admitted; but we have seen British Camemberts and British Gorgonzolas which were little inferior to foreign samples, and which would undoubtedly command a remunerative price in the market. Cheese-making is not a speciality with the British farmer. He has been so long accustomed to leave the dairy and the hennery to his wife, that little advance has been made.

Abroad, an outsider cannot fail to be struck with the differ-

ence in the systems, and the number and variety of products which are drawn from the dairy. In Holland the industry is one of the most important in the State. In France, without our machinery, our appliances, our energy, or our cattle, the best of butter and cheese is made, largely consumed by a people who are especially connoisseurs of both, and also exported in gigantic quantities. In North Italy the quality of butter and cheese is first-rate. In Switzerland the butter is little excelled by that of any country, and cheese is a staple industry, the Gruyère and Emmenthaler being sent all over the world, while the cows are of the highest type; and yet the people are as primitive as their appliances. If it were possible for any individual to glance through England during the past five oppressive years, and note the difference in the results of corn and dairy-farming, or mixed farming, he would find that in nearly every case the dairy had paid its way, or perhaps made a large profit, where the corn-farm had lost heavily; while upon mixed farms the dairy has often been the salvation of the whole concern. No doubt there is great difficulty in changing a system, especially where the buildings are unsuitable and the distance from a station great. The farmer, too, may be deficient in his knowledge of dairying, and not able to trust himself, or he may not be able to find the necessary capital. There should, however, be no half-way house in a business of this sort; a man must lay himself out to do it well, or not at all. For instance, a bad cow is worse than no cow, as she loses money; but a good one makes money, and a number of good ones, well managed, mean decided success. Good cows, however, are not easily obtained; therefore, the best way is to look well into the future, and breed them from the best milking strains on both sides; dairy exhibitions at least have shown the public what these are, and where they are to be found.

"The best specimens of each breed are very nearly perfect, and as such may be taken as the highest expression of the ideal which men have been seeking to attain for generations. We have cows

which give upwards of 1,000 gallons of milk in a year; others, again, milk heavily for five or six years, and afterwards fatten off for the butcher. Young animals there are, too, which attain a weight of 40 imperial stone by the time they are a year old. This is understood as early maturity, and Shorthorn oxen have attained, at four or five years old, a live weight of more than a ton and a half. Now these are the qualities in cattle which are commercially valuable to the dairy-farmer—copious milking, early maturity, hardy constitution, aptitude to fatten, and fecundity. A due combination of these properties is what practical dairy-farmers seek, more or less successfully, in their dairy stock."

With reference to the subject of cheese-making, it has often been noticed that there is no cheap article in the market to suit the class of people who consume the Edam and Gouda or Dutch cheeses. It will, of course, be explained, as it always has been, that British skim-milk cheeses will not pay; and, as a maker is guided by a market quotation, he naturally decides in accordance with it. Nevertheless, there can be little doubt that a good sample would sell well, and we have known many cases in which well-made cheeses for home consumption have been specially admired, and would find a ready sale if the public could get at them.

If we look at the production of butter, we do not find that the large body of makers either adopt the best systems of feeding or manufacture, or keep the most suitable stock. Butter cows are not picked up in the same way that a dealer buys at fairs and markets for the London cow-keeper, nor are they to be fed upon inferior pasture, grains, and chaff of mean quality. If the cow is a machine, she must be fed like one, and, if rich milk is required, the food must be good, for, although milk may be obtained from grains, it is well known that it yields little butter. Some persons argue that high feeding is a mistake; but the merest tyro can prove incontestably, if he will take the trouble,

that it leaves a much larger margin of profit than low feeding, and that if there is no cake or corn bill, the grocer will have a very small butter bill. There are so many opportunities for a farmer to learn the value of particular breeds of cattle, that it is astonishing how tenaciously he sticks to his antiquated mongrel-bred cow, and how carelessly he breeds, without ever inquiring whether the bull he uses has any milk record in his veins; to many farmers, indeed, a bull is a bull. In many districts the butter made in the country is all consumed in the nearest towns, and is either sent to the grocers' shops or sold in the markets, according to the custom of the district; but even here it does not go very far, salt butter supplying the lower classes. In other parts, where less butter is made, very little is sent into the towns; while in the large cities, in spite of the adoption of names such as the finest "Aylesbury" and prime Dorset and Devon, it is too well known that most of the butter thus ticketed is imported and made up for the purpose.

If we take the leading dairy county, Cheshire, with its 94,000 cows and some 600,000 people, we have nearly seven persons to each cow. Allowing for cows which are not in milk, for sucking calves, for heifers, and bad milkers, it will at once be seen that the consumption of milk alone would require this number; and that, even in Cheshire, the cows are not half numerous enough to supply the population, when we consider the butter and cheese they consume. Going to the other extreme, we have Cambridge with 190,000 inhabitants and 13,000 cows and heifers, or one to nearly fifteen persons. If we could ascertain the exact number really in the dairy, allowing for calf-feeding, dry cows, and so on, it is questionable whether one cow would not have to stand against twenty-five head of population; and the simplest calculation will show what a state of things this implies. Sufficient, however, will be understood when it is stated that in 1880 we imported 2,326,305 cwts. of butter—which means 260,000,000 lbs., or 7 lbs. per head of the population; and 1,750,000 cwts. of cheese,

equivalent to $5\frac{1}{2}$ lbs. per head. Suppose that we assume a cow to give 300 lbs. of butter a year—which the average of cows assuredly do not—it would take 866,000 cows to supply the butter alone.

For many years a great movement has been at work, in the improvement of our meat-producing cattle; but unfortunately, milk has been too much lost sight of. We have the grandest beasts in the world; let us hope that the uncertainty of the future will cause the dairy-farmer to adapt them more to his purposes, and the present dairying movement to continue to advance, and that the farming classes will vie with each other in the production of big milkers, of good milk, good butter, and better cheese than that of to-day

CHAPTER III.

MILK, BUTTER, OR CHEESE.

Every one engaged in the manufacture of dairy produce is actuated by the desire for a profitable result, and to this end he should adopt whichever system brings in the largest return. In some cases milk pays the best, but then all producers are not able to sell it—they live at an inconvenient distance from a railway station, or the carriage is too high to tempt them to go into the trade. In other cases butter pays its way, and is readily sold at remunerative prices, whereas large numbers in some counties prefer the manufacture of cheese. Every man has his reasons for his system of disposing of his milk, and they are generally very intelligible. The custom of the country—a pretty sure guide—is generally founded upon a knowledge of the capabilities of the soil and of local breeds of cows; hence it should never be despised, but rather utilised, whether an improved breed be kept or not.

Men need no teachers to tell them that the first thing they want in a cow is plenty of milk. A handsome animal is all very well in its way, but the farmer who has to look to his cows for his rent and subsistence speedily ceases to admire beauty in the bad performer. Before he can decide whether his aim is to be butter or cheese making, he should commence at the beginning, and secure plenty of milk. To this end he must select well-bred animals, and then keep them well. A cow that will not give 600 gallons in a year should not be retained, and by rigidly weeding out

inferior and bringing in first-rate milkers, the farmer is laying the corner-stone of success. It is true, in one sense, that what goes in at the mouth goes out at the pail, for a good cow will return the cost of good food with interest, but it were folly to expect a cow which is essentially a butcher's animal to do anything of the kind. In the same way that breed regulates the quantity of milk, so does it regulate its composition. Some cows give an excess of fat, others of curd, hence their value as butter or cheese makers; but again the food comes in, and in a given animal the percentage of cream may be increased by liberal supplies of a certain diet. In establishing a dairy, for instance, a man would be foolish indeed who purchased a herd of Sussex, or Hereford, or Devon cattle, and he would be similarly unwise to be guided by popular fancy and secure fashionable Shorthorns. Ayrshires are good milkers, Channel Islands cows are good butter-makers, Dutch are more suitable for milk-selling, and dairy-bred Shorthorns are among the best for cheese; they are, moreover, largely kept in dairies of all kinds, because they always sell well when dry, and, as a large owner once remarked to us, "they keep the money together." The man, then, who starts with the right class of cow, and feeds it well without forcing, is certain to obtain the best yield.

There are many things to be remembered—some of which experience teaches every man—the effect of temperature, for instance, upon yield and quality. In the flush of summer, when the cows are milking at a maximum, a fall in the temperature will cause it to drop very rapidly; whereas a rise will also affect the yield, but from another cause. Every cow-keeper should understand the relative values of foods, or he may be feeding to waste. The most suitable diet for milk-selling is not such as butter-makers would use, while in all cases the system of the cow must be supplied with the requisite fuel to keep it in working order before it yields one drop of milk. The waste of tissue has to be repaired and the system heated; hence, unless additional food makes up the difference, it follows that in cold weather the fats in the milk will

not be so large in quantity as in hot weather. In cows suitable for beef-making, the surplus food, over and above that necessary for the animal's existence, goes in the production of flesh and fat, whereas in good dairy cows it makes milk; thus, it may be argued, that a certain quantity of food being set aside for subsistence, the additional ration is transformed into milk. Some persons, with liberal hearts and wise heads, give their cows corn or meal all the year round. We remember a case of an individual who did this, comparing accounts with a neighbour who kept a similar number of cows, but who was the reverse of liberal with his corn, and the result was a difference of 60 per cent. in his favour, besides the fact of his cows wintering with less trouble.

To return to the quality of the cow. A large dairyman once said that years ago he fixed an average or standard which he expected all his cows to reach, and at once began weeding them, selling all that did not reach it. He raised heifers from the stock that he kept, and when one came into the dairy, if she failed, allowance for age being made, he sold her at once. He found that those he bred did much better than those he purchased, and when at last he had collected a respectable herd, he purchased a Jersey bull, and his present stock is from that source. If every farmer acted upon this principle our native cows would soon present a creditable appearance, provided the weeds went to the butcher; but, unfortunately, too many of them get into other hands, and there always will be persons who are tempted to buy a milker at a low price, if she only gives a quart a day.

"Weed out the poor cows," said an American lecturer. Any one with an inferior milker on hand is much to blame to sell her for any other purpose than beef-making. Such a cow should be milked while the flush is on her, and then dried and fed for the butcher. It is positive cruelty to sell her in milk.

"In a new dairy," said Mr. Gosse, when addressing a farmers' club, "never breed in and in if you wish to retain strength and constitution. Some persons use bulls which are a disgrace to

them; my experience has been that the male is of the most consequence in improving stock. The cows which are the largest milk-producers do not carry much condition, but if well bred, when dry, fatten as quickly as others.

"I should choose a cow or heifer tolerably wide in its hind quarters, deep in carcase, rather thin and lengthy in its fore-quarters, a long neck, a clean, long head, and a square dug, not too thick in leather. My experience has been that a short head and neck and thick forequarters never gave much milk, and this applies as much to a Shorthorn as to any other breed, nor was the milk any thicker. In our local shows, as well as at the Royal, I have often noticed the ribbons put on to a cow (shown as the best cow in milk or in calf) which did not appear likely to give even half a gallon of milk at a meal, and would need a foster mother to fatten her calf, and herself in condition nearly fit for the butcher's stall. I cannot think such a cow is what most of our dairy farmers require. My brother, who at One House Hall kept a dairy of fourteen cows for more than forty years, objected to a large cow, and his were always about medium size, and for nearly forty years were reds, obtained at first from Mr. Moseley's strain, and were generally as near the shape I have noted as he could keep them."

Many opinions have been given as to the shape of a milker; but although it may be some guide, yet we have seen many strange contradictions, and after all, it can matter very little what the shape is if the milking property is there. "A good dairy cow has four points under the belly between the hind legs; she is the animal to choose for dairy stock, breed or no breed." We like to see some sign of breed; but there is an element of truth in this remark.

Mr. Gilbert Murray, a well-known authority, has stated that an average cow of any leading breed, fed upon 60 lbs. a day of hay and roots, and 10 lbs. of cotton cake, India-meal, bran, and bean-meal, will yield 750 gallons of milk in 12 months. This is

optimism with a vengeance. Allowing that the animal is in milk 46 weeks, she would require to give nearly 10 quarts daily during this period. We know very well that such a result can be attained, but only with animals of a very high class, certainly not with average specimens. In proof of this, Mr. John Naden, who denied the correctness of Mr. Murray's statement, made some inquiries, with the following results, showing the average in eight dairies for five years:

	1876.	1877.	1878.	1879.	1880.	AVERAGE.
	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.
No. 1 ...	430	547	593	481	443	$498\frac{4}{5}$
,, 2 ...	507	628	500	477	441	$510\frac{3}{5}$
,, 3 ...	643	564	492	465	396	512
,, 4 ...	464	420	481	285	293	$388\frac{3}{5}$
,, 5 ...	451	384	383	365	332	383
,, 6 ...	565	640	619	483	409	$543\frac{1}{5}$
,, 7 ...	545	445	455	402	444	$458\frac{1}{5}$
,, 8 ...	580	587	495	331	382	457
Average...	$523\frac{1}{8}$	$526\frac{7}{8}$	$592\frac{1}{4}$	$411\frac{1}{8}$	$392\frac{1}{2}$	$471\frac{7}{40}$

The number of cows in the eight dairies was, in 1876, 197; in 1877, 192; in 1878, 181; in 1879, 184; and in 1880, 171.

Without doubt, there were many cows among these which reached 750 gallons; but it is a significant fact that in only three dairies was 600 gallons exceeded; and we may take this as an example of what the ordinary class of dairy cows kept by intelligent men perform.

We will now quote an instance, which is the most remarkable example of dairy success of which we have ever heard; and it is a standing proof of the wisdom of creating one's own dairy by selection of breeding stock, and keeping nothing but the finest milkers. Mr. Tisdall's splendid system—carried out as it is to the letter, or he would never have been able to furnish the very full statistics which he has done—is a monument upon

which all dairy-farmers should look and turn from only with the determination to imitate. What many persons have been teaching in theory is here demonstrated in practice, and the results which we indicate below are such as will amply repay any one who has the ability and perseverance to achieve them. In the table compiled for the assistance of the Council of the Dairy-farmers' Association, Mr. Tisdall gave the actual yield of 60 cows for every month during 12 months, showing the average of each per day and per month, for the whole milking period. The averages of the whole 60 were also shown in the same manner. Only 8 cows fell below 10 quarts, and only 4 below 9; 20 cows averaged 10 to 11 quarts; 10 averaged 11 to 12 quarts; 7 averaged 12 to 13 quarts; 12 from 13 to 15 quarts; 1 averaged exactly 15 quarts, and 1 17 quarts for the whole 12 months. This last animal gave, at this rate, 1095 gallons of milk, or above 11,200 lbs. Fifty-seven of the cows milked 8 months, 51 milked 9 months, 42 milked 6 months, 31 went with milk 11 months, and no less than 18 went the whole 12. The following figures will show the averages of the whole for each month and for the year, and from them many lessons may be learned:

1st.	2nd.	3rd.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.	12th.
18·07	17·09	15·03	13·75	12·55	11·34	9·72	7·94	6·01	4·67	3·05	1·85

Daily average whole period in milk.
11·5

The average period of each cow in milk was 10·83 months. The table was the basis of the awards for the milking prizes at the Dairy Show in 1880; it is a record of the compiler's best Shorthorns, and the period is the 12 months immediately after calving.

If, then, an individual intends to form a dairy for milk-selling, he will be wise to follow Mr. Tisdall; commence with good animals that prove their ability at the pail, put them to a bull whose

mother was a first-rate milker, and save all the best heifers. The milk trade of our great towns is so large that producers in distant counties daily send by rail to meet the demand, and are content to pay from 1*d.* to 2*d.* a gallon for carriage, find churns, and cart them to their station for less than 1*d.* a pint. This is a striking proof that they find it pays them better than cheese or butter making; but as dairy-farmers are gradually increasing nearer to the large centres, and even in the suburbs, competition is yearly becoming stronger, and the demand not always equal to the supply. Hence, it is a serious question whether more attention ought not to be devoted to cheese and butter, which are always in demand, than is done at the present time—more especially as they are likely to keep up their prices; while there is every probability of milk becoming still cheaper when the railway companies have revised their tariffs, as they are being severely pressed to do. The demand during the past few years, in London, coupled with the liberal rates of the Midland Railway Company, did a great deal to depreciate cheese-making in the midland counties; and this is much to be deplored, as these cheeses are among the finest made in England, and when very perfect are not to be excelled in any country. The industry needed augmentation rather than destruction, and it is to be hoped it will be largely revived before long.

We have paid 5*d.* a quart for milk in London, and we have purchased very good samples indeed at 3*d.* Some of the large dairy companies have done much to reduce the former exorbitant figure, whereas the latter is evidently charged by cow-keepers who have no carriage to pay, and no middleman between them and the public. The quality of the best milk sold is now very superior to what it was, and every farm or dairy where it is sold or produced is inspected periodically—as they should be, for in the country the management is very lax—and any fault in their sanitary state is at once pointed out and repaired. A milk-seller who sends by rail has, above all things, to consider the temperature of his milk, or he

may, in changeable weather, be a considerable loser by its spoiling. It is now the custom to cool and aërate the milk; the operation not only enabling it to undergo the journey better, but to keep longer, and it removes stable or farm-yard taints, which at one time were often present in London milk. Many persons use a machine made by Lawrence, which cools the milk before it can possibly have been injured by any change. If milk is preserved in proportion to the rapidity with which it is cooled—as it really is, by the destruction of vital organisms within it, if it is subjected to sudden cold—then those who do not use a cooler are foolish indeed. As the milk comes from the cow at about 95°, it is passed through the refrigerator—being aërated and strained at the same time—and comes into the churn at 60°, ready to be sent away. The "churn" is a familiar article to all railway travellers, in the form of huge tins, which usually hold 8 barn gallons, or 174 lbs. If a churn is filled there is no necessity to weigh it, but otherwise the custom of weighing, which is largely growing, should be resorted to. The official report on the Carlisle Show, in the "Journal of the Royal Agricultural Society," says:

"In buying large quantities of milk it is practically found to be impossible to get accurate results by measuring, so a machine has been invented for weighing it, by which means the quantity to an ounce is quickly and surely known. It consists of a weighing-table about 3 feet 6 inches square; on this are two A-frames, between which is supported, on trunnions, a copper tank, holding 35 gallons, or about 3 cwt. of milk. In one-half of this is fitted a wire strainer, 80 meshes to the inch, through which the milk is poured. The tank being full, the contents are weighed, a catch is released, and the whole tipped up into a tank on the floor, from whence it is used as required."

Special fast milk trains travel on most lines morning and evening, delivering the milk a few hours after it is drawn from the cow; and as we write, we notice a farmer in Cheshire advertising that he will send skim-milk, carriage paid, to any part

at 4*d.* a gallon. The following are the rates of the chief railway companies.

GREAT EASTERN RAILWAY.

Returned empties, *free*, but 1*s.* a week labourage.

Distances under	20	miles,	½*d.*	per gal. ;	minimum,	6*d.*
,,	40	,,	¾*d.*	,,	,,	9*d.*
,,	100	,,	1*d.*	,,	,,	1*s.*

GREAT NORTHERN RAILWAY.

Returned empties, *free.*

Distances under	20	miles,	½*d.*	per gal. ;	minimum,	6*d.*
,,	40	,,	¾*d.*	,,	,,	9*d.*
,,	100	,,	1*d.*	,,	,,	1*s.* 0*d.*
,,	150	,,	1¼*d.*	,,	,,	1*s.* 3*d.*

LONDON, BRIGHTON, AND SOUTH COAST RAILWAY.

Not exceeding	10	miles,	½*d.*	per gal.;	minimum,	6*d.*
,,	25	,,	¾*d.*	,,	,,	9*d.*
,,	50	,,	1*d.*	,,	,,	1*s.* 0*d.*
Above	50	,,	1¼*d.*	,,	,,	1*s.* 4*d.*

LONDON AND NORTH-WESTERN RAILWAY.

Not exceeding	20	miles,	¾*d.*	per gal.;	minimum,	9*d.*
,,	50	,,	1*d.*	,,	,,	1*s.*
Above	50	,,	1¼*d.*	,,	,,	1*s*

For cream double the above rates.

LONDON, CHATHAM, AND DOVER RAILWAY.

Not exceeding	10	miles,	½*d.*	per gal.;	minimum,	6*d.*
,,	25	,,	¾*d.*	,,	,,	9*d.*
,,	50	,,	1*d.*	,,	,,	1*s.* 0*d.*
Above	50	,,	1¼*d.*	,,	,,	1*s.* 4*d.*

MIDLAND RAILWAY.

Not exceeding	20	miles,	½*d.*	per gal.;	minimum,	6*d.*
,,	40	,,	¾*d.*	,,	,,	9*d.*
,,	100	,,	1*d.*	,,	,,	1*s.* 0*d.*
,,	150	,,	1¼*d.*	,,	,,	1*s.* 3*d.*
Above	150	,,	1½*d.*	,,	,,	1*s.* 6*d.*

GREAT WESTERN RAILWAY.

Returned empties, 2*d.*

Distances up to	70	miles,	1*d.*	per gal. ;	minimum,	7*d.*
,,	100	,,	1¼*d.*	,,	,,	9*d.*
,,	150	,,	1½*d.*	,,	,,	1*s.*

SOUTH-EASTERN RAILWAY.

Milk, ¾*d.* per gal. over 10 miles and under 25; minimum per can, 9*d.*
1*d.* per gal. over 25 miles and under 50; minimum per can, 1*s.*
Over 50 miles, 1¼*d.* per gal.; minimum, 1*s.* 4*d.*
Returned empties, 2*d.* per can.

SOUTH-WESTERN RAILWAY.

Cream, three-quarters of parcel rates.
Returned empties, *free.*

Distances.	Not exceeding 6 Imp. Gals.	Above 6 and not exceeding 9 Gals.	Above 9 and not exceeding 12 Gals.	Above 12 and not exceeding 15 Gals.	Above 15 and not exceeding 18 Gals.	Above 18 and not exceeding 21 Gals.
	s. d.	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*
Not exceeding 10 miles	0 6	0 7	0 8	0 9	0 10	1 0
Over 10 to 25 ,,	0 7	0 8	0 9	0 10	0 11	1 1
,, 25 ,, 40 ,,	0 8	0 9	0 10	0 11	1 0	1 2
,, 40 ,, 50 ,,	0 9	0 11	1 1	1 3	1 5	1 7
,, 50 ,, 75 ,,	0 11	1 1	1 3	1 5	1 7	1 9
,, 75 ,, 100 ,,	1 2	1 4	1 6	1 8	1 10	2 0
,, 100 ,, 125 ,,	1 4	1 6	1 9	2 0	2 4	2 8
,, 125 ,, 150 ,,	1 6	1 8	2 0	2 3	2 6	2 11
,, 150 ,, 175 ,,	1 8	1 10	2 2	2 6	2 9	3 2

We have referred to the fact that milk will not travel so well if it is not cooled immediately it is drawn. An interesting experiment in support of the value of cooling was made by Fjord, and related in the bulletin of the Jersey Cattle Club. Some fresh milk was divided into three portions, one of which was set in ice-water at once, a second was set in ice-water at the expiration of an hour, and the third portion was carried in a waggon for three hours, and then stood in ice-water. Each portion was allowed to stand for ten hours. The result was that the yield of butter from the second and third portions was 70·3 and 73 as against 100 parts in the first; showing a considerable gain by the method of instant cooling, although it should be stated that the loss is not always so great as in these cases. The same experimentalist shows that if the milk is heated to 104°

directly it arrives at its destination, loss is almost entirely avoided; but this process is not necessary if a centrifugal separator is used.

There are, of course, some little annoyances to which milk-sellers are liable; the business is not all *couleur de rose*. Sometimes the London dealer suspends the despatch of milk for a day or two, and however troublesome this may prove to the producer, it is a prerogative which the dealer is bound to retain. This being the case, the ability to convert the milk into butter or cheese at any time should be present. The producer, too, will find it necessary in some cases to guarantee a certain quantity, and he will sometimes find the dealer exacting more, especially if he has to depend upon him to any extent; but if butter or cheese making is at his finger-ends, as it were, he will be independent, and able to avail himself of the best markets and the best paying seasons.

As a general rule, the producer uses his own churns; but in cases where small quantities are sent, or where the transactions are irregular, they are sent by the dealer. It will always be found the best policy to use the best churns that are made; those of tinned steel are by far the most durable.* There is another method of sending milk, but in smaller quantities. The Aylesbury Dairy Company have introduced the Warren glass bottle and a patent jar, both of which are air-tight, permit of thorough cleaning, and are exceedingly cheap.†

* A churn recently invented by Mr. Marsden, of Wirksworth, is worthy of notice. The bottom and bottom hoop are constructed with a flange for attaching the body of the churn in one continuous iron casting, all being in a single indestructible piece. Another churn, invented by Mr. Legge, of Berkeley, is provided with wheels. The bottom has a flange for the attachment of a bracket, which supports a small axle on which the wheels are fixed. The wheels are at the back edge of the churn, whereas in the front are feet upon which, with the wheels, it rests.

† Bottled milk is largely sold in Paris, for there is no fear of adulteration under the system and those who have purchased it speak very highly of it. The idea has been tried in New York, but the extra trouble prevents it being so successful as could be wished.

It may be as well to remind intending milk-sellers to be careful that milk of inferior quality is never sent away. Some cows—they are not so scarce as many suppose—give milk which does not reach the required standard; consequently, if tested it would in all probability subject them to fine and disgrace. During the past year a highly respectable farmer was convicted under the Food Adulteration Act; but, conscious that his milk had never been adulterated, he caused the matter to be investigated, with a result that must have been gratifying to him in one sense, for the real delinquent was his cow.

Having said thus much with regard to the production of milk for sale, the farmer will be able to draw his own conclusions, apply them to his own case, and estimate the probability of profit as against butter or cheese making. We have referred to the subject of the sale of cream in the chapter upon cream itself, and it will be noticed that we there examine the percentage of butter from milk. Without viewing it in an extreme light, we find that a gallon of ordinary milk yields butter worth 4½*d.*, but to this the value of the skim-milk must be added, and this should bring it up to 7*d.* at the very least. The dairy-farmer we have quoted says he would be very glad to get 6½*d.* a gallon all the year round for his milk; consequently, it must be assumed that, estimating various expenses in connection with milk-selling, there are many producers who actually receive less than this. We must therefore infer that as butter makes a better price in autumn and winter than that we have assumed as its value, it is at least as profitable as milk-selling, unless, indeed, the producer has an exceptional contract or is advantageously situated. Mr. Murray, however, gives the percentage of butter at about 4 per cent., which in our opinion is excessive, but which would decidedly make butter-making more profitable than milk-selling. There is, however, one rule from which a farmer should never deviate when he is about to adopt a system—he should test his cows, not only as to the quantity of milk they give, but the yield of butter

per gallon, as well as the yield of curd, and he will then be able to realise, as he can in no other way, which system will pay him the best.

It was reported some time ago that the cows of the late Mr. Carrington (an especially good lot) made, in the season of 1880, an average of 4 cwts. of cheese each, which sold at £4 per cwt.—a price farmers would like to obtain a little oftener. It may be, therefore, taken for granted, that if by the sale of cheese, a farmer can realise 6*d.* per gallon of his milk, he does remarkably well. It must be remembered that as in butter-making the skim-milk is of some value, so in cheese-making something may be reckoned for the whey, the whey-butter, and the milk produced when cheese-making is over. It is, however, tolerably certain that of the three industries the ordinary system of cheese-making is the least profitable; we wish, however, in this work to especially direct the attention of all dairy-farmers to the manufacture of what may be termed fancy cheeses, which are found so profitable on the Continent, and which ought to be made in our own country.

CHAPTER IV.

MILK.

It is astonishing how large is the number of persons who are destitute of all knowledge with regard to the composition of milk; and, while we may excuse in the lower classes the absence of information as to the food they daily consume, there is no reason why the alumni of our public schools should be crammed with classics, to the exclusion of subjects which affect the future welfare of themselves and all over whom they may be placed.

In treating of milk, it is necessary to show of what it is composed, as well as the nature of its actual constituents; to explain the composition of skim and butter milks; the value and composition of condensed milk; the value and methods of analysis; and to refer to the question of milk adulteration.

Milk, then, is a liquid composed of saccharine and albuminoid matters held in solution, which is rendered white by the presence of an infinite number of particles of fat enclosed in bags or envelopes, and which can be easily seen by placing the merest particle of milk under the microscope. They are not transparent, but they reflect light when it penetrates the milk. The opacity of milk is due not to the fat, but to the casein and the casein envelopes which hold it; and this fact will be rendered more simple to anyone who examines milk from which the casein is extracted. Skim-milk contains more fat than buttermilk, according to Dr. Cameron, although this evidently depends upon the system under which it was skimmed, but it is less opaque, owing

to the presence of more particles of casein in the latter. When newly drawn from the cow, the temperature of milk is about 95°, and, like water, it freezes at 32°. Its principal constituents, fat and casein, are among the most valuable and popular foods in all countries, for they represent butter and cheese. When these are abstracted, the liquid remaining is termed "whey," which consists of sugar and water and a few traces of mineral matter. The quality of milk depends in a great measure upon the size and quantity of the bags or globules of fat, which vary according to the breed of the animal, the food it is fed upon, and the season of the year.

The following is a fair example of the composition of milk, but it should be observed that different animals present slightly different features, some showing a greater value in fat, others in sugar, and others in casein; and it is owing to this fact that some races are preferred for cheese-making, others for butter-making, and others, again, where water preponderates, for milk-selling.

		Skim.	Buttermilk.
Water	873·00	89·65	89·62
Butter	30·00	0·79	1·67
Casein	48·20	3·01	3·33
Sugar	43·90	5·72	4·61
Mineral matter	4·90	0·83	0·77

As there are discrepancies of a serious nature in the various analyses issued with the authority of eminent individuals, we add the following tables:

	Munster Dairy School.	Sheldon.	Cameron.
Water	876·00	872·50	870·00
Fat	39·80	38·60	40·00
Casein	30·20	32·80	41·00
Albumen	4·00	—	—
Sugar	43·00	48·90	42·80
Mineral matter	7·00	7·20	6·20

If we would compare the milk of the cow with that supplied by other animals, we are enabled to do so by the following table,

but it is necessary to say that almost every well-known analyst differs in his figures from those who have published similar analyses before him:

	Cow.	Goat.	Ewe.	Mare.	Ass.	Sow.
Solids	135·80	155·10	167·68	96·90	109·88	182·40

IN 100 PARTS.

	Cow.	Goat.	Ewe.	Mare.	Ass.	Sow.
Water	87·00	84·49	83·23	90·10	89·01	81·76
Butter	4·00	5·68	5·13	0·99	1·85	5·83
Casein, etc.	4·10	3·51	6·97	1·78	3·56	6·18
Sugar	4·28	3·69	3·94	6·69	5·04	5·33
Mineral Salts	0·62	0·61	0·71	0·44	0·52	0·89

The great value of the analysis of milk is that it enables a cow keeper to learn the value of his animals for his particular purpose; and while persons do as some are always likely to do, buy or breed animals of no particular family or grade, they are certain to be in a great measure ignorant of their capacity for butter or cheese making. The following table, for instance, shows the difference in six breeds, and is, consequently, of some value:

	Shorthorn.	Ayrshire.	Jersey.	Dutch.	Devon.	Swiss.
Sugar	3·76	3·90	3·76	4·35	4·23	4·10
Casein	4·41	5·08	4·37	4·21	5·29	5·02
Fat	4·10	3·75	5·87	2·90	4·96	3·60

We have referred to skim and buttermilk, both of which have especial value, and not alone for pig-feeding, which at present is their destination, but as food for the people, and everyone producing milk for sale is to blame if he does not attempt to place supplies of both articles in the market. Sweet buttermilk is equal as a food to many town samples of cream, and there is no reason why, if the churning is conducted with sweet cream as it usually ought to be, it should not be sold sufficiently early to enable it to be kept some days. Skim-milk again, can be sold, if the separator is used, the day it is drawn from the cow, and at a penny a quart would be one of the cheapest and most popular foods if it could be obtained in towns. In 1000 parts of rich milk there are

above 850 of skim, which contains 10 parts of fat, 24 parts of casein, 3½ of albumen, 40 of sugar, 5½ of mineral matter, and the rest water. The same quantity of skim-milk, or say 800 parts, should yield 80 parts of cheese, which would be composed of water 47, fat 3, nitrogen 26, sugar 4; whereas the cheese-milk, the difference between the 80 parts of cheese and the 800 parts of skim-milk, would contain 32½ parts of sugar, and 6 parts of fat and curd.

The buttermilk is also rich in properties which nourish the animal system. In 1000 parts of cream we have 815 parts of buttermilk, in which we find 31 parts of sugar, 30 of nitrogen, and 7 of fat; a sufficient proof of its value. It must, however, be remembered that cream varies in bulk considerably, being largely affected by the temperature.

If we come to a division which is better known, and perhaps more appreciated by all who keep cows, we find that of 100 parts of rich new milk 15 parts should be relied upon for sale as cream, and the balance as skim; hence it is easy to determine which system pays the best—the sale of new milk, or of cream and skim—where it is a question of one or the other.

A pint of cow's milk contains 546 grains of carbon and 43¾ grains of nitrogen, consequently, as the average daily consumption of a man is 4800 grains of carbon and 300 of nitrogen, it follows that about 8 pints would satisfy him.

According to Alvord, a high authority in America, 5000 lbs. of milk contain 25 lbs. of nitrogen, 12 lbs. of phosphoric acid, and 7 lbs. of potash, which, as fertilizers, are of the value of nearly £2; consequently, when milk is sold and carried entirely away from the farm, it should not be forgotten that a certain sum is lost in manurial value.

With reference to the adulteration of milk it is an established fact that the system is on the decrease. The vigour of local officials and the firmness of magistrates have materially helped the public to obtain a good article. Professor Wanklyn stated that a

few years ago he analysed in a given time 1000 samples of London milk, all of which were watered; some to the extent of nearly one-half, and he believed that prior to 1872, nearly nine-tenths of the milk sold was either watered or skimmed, to a palpable extent. The system of selling milk to the trade is by the barn gallon, a measure which the Weights and Measures Act was framed to reach, but fails to do so, inasmuch as the barn contains 17 pints, and it is perfectly legitimate to buy and sell 17 pints, if illegal to call it a barn gallon—and so the miserable anomaly lives. An imperial gallon of milk weighs 10 lbs. 4½ oz., a barn gallon about 21 lbs. 13½ oz., and a churn of 8 barn gallons, the vessel daily employed to send the milk to town in, a little over 174 lbs., or 4 lbs. heavier than the same quantity of water; an imperial gallon of the latter weighing exactly 10 lbs.

Defects of Milk.

Bitter Milk is caused by damp and dark cellars, or want of cleanliness. It generally shows yellow or dirty grey spots in its cream, which forms in a layer of unequal thickness, and produces a soft, badly-tasting butter. The occurrence of this defect may be prevented by keeping the milk and every implement used in its manufacture scrupulously clean.

Red Milk, if not traceable to foreign matter in the food, may be caused by wounds in the teat or effusion of blood in the interior of the milk ducts. This milk has a bad taste, and is unfit for cheese-making, but is not injurious to health. If no external wounds can be discovered, it will be well to consult a veterinary surgeon.

Watery Milk is very thin, bluish, and contains less than the normal quantity of fat and casein. This defect generally arises from watery or frozen foods, wet pastures, etc. An immediate change of food, to which salt and some tonic ingredients, as gentian, etc., are added, is a good remedy.

Granular Milk contains small grains of lime (phosphate and carbonate), which can generally be felt on touching the udder, and are sometimes present in such a large quantity as to completely obstruct the milk ducts. The cause of this complaint is not known, and animals suffering from it must generally be killed.

Blue Milk is sometimes caused by plants which the cows have eaten (*Myosotis*), but more often it is the poisonous aniline blue created by indigestion, in consequence of bad food, especially in the autumn pastures. First a few blue spots appear on the surface of the milk, which gradually increase in number, and after skimming them off, the blue colour reappears on a thin oily layer, and the milk assumes a very bad taste. A change of food and proper care will generally effect a cure.

Slimy Milk, although not injurious to health, has a disagreeable appearance, which is attributed by some to the transformation of the milk sugar or to unclean pails; others think that it is owing to the influence of a certain plant (*Pinguicola vulgaris*). In Sweden the pails are rubbed with this plant, to prevent the milk from turning sour.

Milk difficult to churn. Sometimes it happens that, notwithstanding constant churning, the butter will not come. A froth is formed of a bad smell and taste, which fills the whole inside of the churn. Careful researches by Dr. J. Lehmann, of Munich, have proved that it is caused—(1) by uncleanliness of the skimmer or churn; (2) by a too prolonged rest of the milk or cream before churning; (3) by sickly properties of the milk; and (4) by partial decomposition of the casein or other component part. The cream which one cannot churn is generally bitter, of a bad smell and taste, which indicates a beginning of putrefaction. We have, however, dealt fully with this question in the chapter upon cream, with which "sleepiness" is much more intimately connected.

A new method of preserving milk in its natural state is adopted in Germany. The process consists in heating the milk

in closed vessels, such as glass bottles, to beyond the boiling point, so as to expel all air-containing germs. The bottles are filled with milk almost to the commencement of the neck, leaving a considerable space between the milk and the cork, which latter is then driven in so far as to allow a space of about half-an-inch between its upper surface and the top of the neck. A layer of paraffin wax is then run in, and thereon is placed a cork disc, which, by means of a staple closure, is kept from rising. A number of bottles so filled and prepared are placed in a chamber or vessel that can be hermetically closed, and able to withstand an inner pressure of four or five atmospheres. Here steam, of about two-and-a-half to three atmospheres' pressure, and having a temperature of the same degree as the milk in the bottles, is introduced, which, on expanding, reduces the space between it and the cork, and through the paraffin rendered liquid. Care, however, is taken to see that the reduction of the space is not sufficient to allow of the milk reaching the cork. The chamber is now cooled down, the bottles removed, and, when cold, the provisional staples taken off. The cork itself is also protected from any germs entering it from the outside by the congealed layer of paraffin, a part of which has entered the cork when in a liquid state under the pressure in the chamber. Milk preserved by this method is said to keep fresh for years, and to have exactly the same taste as new milk.

CHAPTER V.

CONDENSED MILK.

Few industries have become so important in so short a period as that which has brought condensed milk so prominently before us, and none deserves success more. We have seen something of the system of manufacture; indeed, we have watched it from beginning to end in Switzerland, and we feel convinced that, whether it be as valuable as fresh whole milk or not, it is thoroughly genuine, and manufactured in the most cleanly and perfect manner. In all the principal factories the system carried out is worthy of our highest admiration, and in no manufactory is the machinery more beautiful or more elaborate. In the early days of condensed milk it was boiled down to one-half and bottled. Later, a Frenchman, named Leignac, condensed it to one-sixth of its bulk. Again, a physician (Dr. Moore), started factories, where he concentrated milk with much success, until retiring, his manager, Mr. House, continued the manufacture on an improved system. From this gentleman, Mr. Borden, of New York, obtained some knowledge of the system adopted, and he soon started condensing in closed vacuum pans, instead of the open ones used in England. Upon this principle Mr. Page started his factory at Cham, on the Lake of Zug in Switzerland, in 1866, and which has become the centre of the largest system of condensed milk manufacture in the world. This milk is known as "Anglo-Swiss," and its mode of preparation is shown below. Factories were subsequently established at Aylesbury and Middle-

wich, which were, in one sense, in opposition to the Anglo-Swiss; but they were acquired by that company, which added another factory at Chippenham, yet another in Switzerland, and a sixth at Lindau, in Bavaria, the manager of which we had the pleasure of meeting at Zug.

In going over the factory the first thing we notice is the manner in which the new milk is recorded as it is received from the producers. The churns are emptied into a large metal vat, which is a weighing-machine as well as a receptacle and strainer. The weight is at once taken down by a clerk, to the credit of the farmer, and, in a moment, it is run out of the bottom into a huge tank, where it remains, pending the commencement of the process. The empty cans are cleansed by men close at hand, being thoroughly immersed in boiling water, after which they stand on end to drain, when a jet of steam is sent into them, and, finally, a jet of cold water. When the tank or reservoir is full, and the milk well mixed, it is run into very large cans, which are stood in an immense copper, some 11 feet in diameter, and holding 35 cans. This copper is filled with boiling water, and the milk is thus gently heated. After remaining a certain time it is poured into another copper, when it is pumped up into a condensing pan and mixed with sugar; not for the purpose of sweetening, but for preserving it. It is then condensed, and the process can be seen —the milk hissing and seething under the heat applied to it—for each cauldron has a little window in the dome. On the outside a gauge shows how far the process is towards completion. The water passes off in the form of steam, which, as it cools, is drawn away in a pipe. The condensing completed, the milk, thick as cream, passes down below into open cans, which are placed in large tanks of cold water, in order that they may be cooled. This cooling is hastened by revolving dashers, which are connected with the steam gear, and which stir the milk until it is fit to go into the filling-room. Here it is run into large canisters with taps at the bottom, something like those used by grocers for

treacle, and from these the little tins are filled by young girls, soldered down, labelled, and packed; the greatest care being taken to prevent any tins being sent away which are not airtight. The rooms in which the tin is cut, the cans and lids made, soldered down, and labelled, are astonishing; and the very boxes in which they are packed are made by most ingenious machinery. The Anglo-Swiss Company employs 800 workmen; and in 1880 it condensed the milk of 14,000 cows (as many as are kept in some of our English counties); and last year the sale of milk was about 25 millions of tins, which, placed in a single row, would reach 1,300 miles.

The Italian Condensed Milk is made at the factory at Locate-Triulzio, near Milan. Dr. Cameron speaks highly of it, and Professor Redwood considers it equal to any in the market. His analysis is as follows:

Fat	10·45
Casein and other Albumenoids	14·84
Milk and Cane-sugar	49·90
Ash	2·12
Water	22·69
	100·00

The Royal Institute of Lombardy has awarded this milk its Triennial Gold Medal for progress in industrial agriculture; and the Medical Congress, held at Genoa, awarded its Silver Medal for the excellence of the milk supplied to the chief towns in Italy.

The Italian works are in a good dairying district, and are managed by Messrs. Bahringer and Meylins. Having first worked for nearly a year with 500 litres a day, these gentlemen, with the experience thus gained, extended their business, and gradually their produce has been sold far and wide. Now the produce of nearly a thousand cows is used daily, and it is hoped to double this, especially as there is capacity for such a quantity. The farmers do not bring the milk direct to the factory, but

deliver it at stations which are within a few miles, and from these it is sent in twice a day. The price paid is about 10s. per 100 litres, exactly 22 gallons, which is under English price; at the same time it pays very well. In this factory sugar is added when the milk is about 60 degrees, to the extent of one-tenth. Condensing is conducted until 70 per cent. has evaporated, leaving 25 per cent. of milk and 3 or 4 per cent. of sediment, which is valuable for feeding pigs. The quantity put into the tins is a little less than 1 lb. (440 grammes), of which 38 parts in 100 are cane-sugar. It is claimed that this milk will keep for 25 days when opened, but longer still in cold weather.

The Scandinavian condensed milk also boasts of considerable patronage, and has received high honours at English, American, German, Belgian, and Norwegian exhibitions. It is well-preserved, fine to the taste, and it is claimed that, added to five parts of water, one part will make the mixture equal to new milk. Dr. Hassall's analysis gives it:

Water	24·94
Fat	9·50
Milk-sugar	15·63
Cane-sugar	32·14
Casein	15·36
Mineral-matter	2·43
	100·00

The analysis of the Anglo-Swiss milk, from an Aylesbury sample, is as follows:

Moisture	25·10
Fat	11·73
Casein	15·17
Milk-sugar	16·24
Cane-sugar	29·46
Ash	2·30
	100·00

The analysis given by the Company is:

Moisture	24·0 to 25·0
Fat	9·5 ,, 10·5
Casein	11·5 ,, 12·5
Milk-sugar	11·0 ,, 13·0
Cane-sugar	39·0 ,, 40·0
Ash	2·0 ,, 2·2

In order to arrive nearer to the value of their analyses, let us see what is the value of the solids of ordinary cows' milk. Wanklyn gives 12·81 as their proportion, made up of 3·63 butter, 3·74 casein, 4·75 sugar, and 0·79 ash; although Continental analysts make slight variations in their results, as indeed do most Englishmen, as we have already shown. Liebig shows condensed milk to be 77·56 of solids and 22·44 water; but while the Anglo-Swiss Company itself gives water as 24 to 25 per cent., other makers show less, although their proportions of fat are also less. Analysis at all events shows that, while the valueless water is almost all got rid of, the orginal solids remain in perfection. That anything is ever added, except sugar, which would increase the bulk, we do not believe; indeed we do not think anything could be added, as without doubt it would prevent what is most of all essential—perfect preservation. So important do makers consider this, that we believe some of them pay their employés extra for any cans they discover with flaws; but, of course, many are damaged in transit, and when a can is so spoiled by contact with the air, the milk or the system is often condemned, although without cause. It has been stated, and by an authority too, that much condensed milk is made from skimmed or partially skimmed milk. That this is not always so is now well known, for many of the factories have been repeatedly visited by scientific men, and samples of the milks analysed. Moreover, if the manufacturers left more water in the milk, which they would do if they extracted the fat, it would not keep, and we have already seen that 86 to 87 parts in 100 of new milk are water, and that when it is condensed not more than 10 per cent. remains.

There are various methods of testing condensed milk without chemical analysis. For instance, mixed with the proper quantity of water and raised to a temperature of 70°, it can be converted into butter like new milk, or if mixed with water in the same way and allowed to stand in shallow pans the cream will rise, and show its value in that respect; deep graduated tubes must, however, not be used, as the mixture of the sugar prevents it rising properly except in a shallow pan. A pound of condensed milk, which is the weight of a single tin, represents 5 pints of new milk, to which about a quarter of a pound of fine sugar is added.

At the London Dairy Show in 1880, a silver medal was offered for condensed milk, and eight samples competed, three of which were unsweetened. Dr. Voelcker gave the following analyses of these samples:

Water	55·96	56·92	51·72
Fat	16·02	17·09	14·33
Casein	8·50	7·62	11·69
Milk-sugar	16·32	16·22	19·51
Ash	2·20	2·15	2·75

The quantity of water in these samples is much too large to enable them to keep, and in his report in the *Dairy Farmers' Journal* the analyst says that one sample had commenced to ferment when opened, and that the others did so the next day. Neither in these nor the sweetened samples had any of the popular preservatives been used.

In the five samples of sweetened milks the proportion ranged as follows:

Water	21·68	to	24·53
Casein	7·43	,,	9·44
Fat	6·22	,,	10·60
Sugar	56·98	,,	58·66
Ash	2·09	,,	2·23

While none of these were overburdened with water, they contained more sugar than the Anglo-Swiss milk, which, however, did not compete. The milks represented were manufactured by

the Swiss Milk Food Company, which has extensive factories at Lausanne, Montreux, and Cossonay; the Anglo-Scandinavian Company, whose factory is at Hamar; the Italian Company; the Swiss Company, whose works are at Vevey; also samples from Mr. J. Hooker, of Thames Street, London, and Van der Woude, of Leeuwarden, Friesland. All the sweetened samples were pronounced excellent, and the award in consequence was made with the greatest difficulty. Dr. Voelcker considers that the quality of condensed milk depends more upon the delicacy of flavour than upon the proportion of butter—at all events, such is preferred by the consumer—and he adds that the samples named above were made from partially skimmed milk. Certainly the low rate of fat in some of the samples would suggest this, and it is a pity that one or two makers will manufacture what is likely to give all condensed milk a bad name.

In America condensed milk is made in some factories in the following manner. When strained, it is placed in small cans, which are stood in a tank of water heated by steam coils. It is next transferred to a larger tank heated in a similar way, and there boiled, by which means the gases in the milk are believed to be expelled, and certain germs destroyed. Next it is strained again, and then transferred to a vacuum pan, where it is boiled and condensed to the required consistency. This copper-pan is oval in shape, and closed in, similar to those used in the Anglo-Swiss factories. It is 6 feet high by $4\frac{1}{2}$ feet in diameter. The steam-coil system is again employed in heating it, aided by a jacket which encloses the lower portion of the pan. On one side of the dome is an eyeglass, and on the other a window, which is illuminated by gas, so that the working can be seen. The original gallon of milk becomes by condensation nearly a quart, or in reality, what $4\frac{3}{10}$ are to 1. Very much is made without sweetening, but we should suppose it is quickly consumed, for it has been shown that unsweetened condensed milk will not keep very long, while sweetened it will keep for years.

Milk condensing has become so profitable a business that several new factories have been started both in Switzerland and Italy, and one of the latest, the Anglo-Italian, we endeavoured to see when in Milan, but were unable to do so. This company, conducted chiefly by Englishmen, is personally managed by Dr. Springmühl, of Milan, whose process differs from that ordinarily worked. The new milk is condensed to one-fifth of its bulk, no sugar being mixed with it, and it is claimed that, by the addition of water, it is equal to fresh milk, and will make butter equal to the choicest—a statement which we doubt. Lombardian milk is very good, and the through route by rail enables the makers to send it to London very rapidly. Dr. Springmühl states that, in the winter of 1881, 8000 quarts were sent to London daily; and, after being restored to their original bulk, sold at the same price as fresh English milk.

CHAPTER VI.

MILK ANALYSIS AND ADULTERATION.

It is somewhat remarkable that, although most important foods permit of their purity being proved by the chemist, yet this is not the case with milk. In many instances it is very difficult, if not absolutely impossible, to draw a line between milk that is naturally poor and weak, and milk, originally of good quality, but which has been diluted by the addition of water; and, aware of this, milk vendors, in far too many cases, are tempted to adulterate. It is natural that this uncertainty of proof should account for the continued high percentage of cases submitted to analysis, and of those reported as unfair, although many magistrates are severe where the report of the analyst is against the sample, and although many analysts return samples as adulterated in cases where the cow is probably to blame, and where the chemist at Somerset House would decline to assist in a conviction. Upon this point we have been favoured with the following remarks by Mr. W. H. Watson, F.C.S.:

"There has been a large amount of work done by various analysts with the view of adopting a limit or standard applicable to genuine milk in all instances. We are beginning to find, however, that no standard can be applied to genuine milk in all cases, inasmuch as the feeding of cows, the different breeds of cattle, and season before or after calving, all materially influence the quality of the milk; and the adoption of a universal limit would render it possible to obtain convictions for selling milk

naturally poor, while a rich milk considerably diluted, and still containing the required percentage of 'solids not fat' (the fixed limit) might escape.

"Experiments have been made by Dr. Voelcker, Mr. Bell (Professor of Chemistry, Inland Revenue Laboratory, Somerset House), myself, and others, on the quality of genuine milk given under different circumstances as to feeding, etc., and these have occasioned various discussions at meetings of the Society of Analysts, the Chemical Society, the British Association, and elsewhere, showing the very different opinions still held by analysts as to what might be fairly fixed as a limit for genuine milk. My own experiments, on between 400 and 500 samples of milk taken from a number of different cows in various dairies, were brought forward by me at the meeting of the British Association in 1879, when a lengthy discussion took place. By these experiments I found in many instances milk from well-fed healthy cows (chiefly in Cumberland) to contain as little as 10·5 per cent. of total solids, and from 8·5 to 9 per cent. of 'solids not fat.' The fat in milk being the most variable constituent, the solids not fat give the most constant data from which to judge as to purity or adulteration. The Society of Analysts have adopted 9 per cent. as the limit for solids not fat, while Professor Wanklyn has suggested 9½, with the remark that he would seldom advise action unless the amount of added water indicated by this standard was more than 10 per cent. Mr. Bell, the Inland Revenue analyst, distinctly stated, at a meeting of the Society of Analysts, February 29, 1879, that 'he did not agree with the limits laid down by that society, because, having taken great trouble to investigate the subject of milk, he found considerable variations in its composition, and that *no one constituent forms a constant quantity in genuine milk.*' Dr. Dupré, Professor Wanklyn, and others are still, however, disposed to adopt the higher standard, and the consequence often is that when duplicate samples of milk are forwarded to Somerset House for analysis (as the Act of Parlia-

ment suggests), there is a wide difference in the conclusions drawn—most frequently the provincial analyst reporting the milk as adulterated, while the analysts of Somerset House give a certificate of purity.

"Each of the standards suggested presents what appears to me to be the unavoidable difficulty that, by their use, naturally poor milk may be erroneously condemned as adulterated, while rich milk may be considerably watered and still allowed to pass; yet it would probably not be advisable to reduce the present standards, lest we increase the opportunities for adulterating the richer milks. In the face of these facts, a limit or standard cannot be universally applied without injustice.

"It appears to me that at least two improvements might be made in the working of the Adulteration Act in regard to milk, thus doing away with anomalous and doubtful evidence. 1. A clause might be inserted providing that all milk sold must answer certain tests as to superior quality; that poor milk must not be sold, whether adulterated or not. There are, however, objections to this. 2. That in the detection of adulteration the sample of milk taken by the inspector at the time of sale should be compared by the analyst, not with any fixed limit, but with a sample taken by himself or the inspector direct from the same dairy as soon as possible after the original sample was sold. The adoption of the first suggestion would compel farmers to keep only such cows for dairy purposes as are capable of giving rich milk, and to feed them in a manner found most favourable for the production of such milk. The consequence of this might, of course, be, that the dairyman, being at a greater expense in the keeping of his cattle, would be obliged to charge a higher figure for the milk produced. The second suggestion, however, appears the most reasonable, simply altering the present methods adopted by analysts for the detection of watering."

If the standard is to remain at 11·5 for total solids, and 9·0 for solids other than fat, it is clear that very great care must be

exercised, because numbers of cases can be cited in which genuine milk has not reached this figure. For instance, in the Dutch class at the 1880 Dairy Show, 4 animals competed for the milking prizes whose solids came out upon analysis at 11·32, 10·99, 11·21, and 11·23. A shorthorn showed 11·47, and a cross-bred 11·36; while in two cases the fat failed to reach 2·5. Again, the principal of the Somerset House laboratory says that a certain case was reported to him in which the milk showed solids not fat 8·54, and fat 2·33, and that even upon these figures he could not report that the cream had been abstracted. A second sample of the milk was obtained by the magistrate's order, and this the public analyst declared to have been deprived of 20 per cent. of its cream. The inspector then visited the farm without notice, and procured a sample from the same cow, which, upon analysis, showed even less fat, while the total solids were about the same. Thus it was conclusively shown that the system of convicting without due precaution is wrong, and that practically a man may be fined for keeping an inferior cow, as though he adulterated his milk. In his paper, read before the Society of Public Analysts, Mr. Bell stated that when he received a sample of poor milk it was his practice to trace it to its source; and of the hundreds of cases which pass through his hands he had only differed from the Society standard in two. He quotes cases, and among them are the following: A sample analysed showed solids 10·40; a second, of the same milk showed 10·75; while a third, taken by the inspector, showed only 10·08. Upon this, Mr. Bell went to the farm, and found 7 half-starved cows, which were milked and the samples analysed. The specific gravity varied from 1·028 to 1·038; their solids gave from 9·10 to 12·34; while in fat they varied from 1·06 to 2·99. Mr. Bell also cites cases in which milks were bought in in the streets, showing:

	1.	2.	3.	4.	5.	6.
Specific gravity	1·026 ...	1·025 ...	1·028 ...	1·028 ...	1·027 ...	1·024
Solids	12·10 ...	12·34 ...	11·65 ...	10·47 ...	10·40 ...	10·0
Fat	4·04 ...	3·94 ...	3·15 ...	3·15 ...	2·59 ...	2·7

And, obtained from the same farmer's cows, showed :

	1.	2.	3.	4.	5.	6.
Specific gravity	1·032 ...	1·033 ...	1·033 ...	1·034 ...	1·033 ...	1·034
Solids	13·76 ...	13·22 ...	13·50 ...	13·50 ...	13·63 ...	12·92
Fat	4·20 ...	3·70 ...	3·90 ...	4·11 ...	3·80 ...	3·20

Thus every sample varied conspicuously, and the sellers were all convicted. These figures show, however, that specific gravity is not an absolute test even of purity, while in three cases adulterated samples showed a total of solids in excess of that required by the Society's standard. Some analysts consider specific gravity of great importance, but it can only be when compared with the solids; and also the ash, which is a guide, as it should correspond with the solids not fat to such an extent that an analyst, desirous of checking work, could do so by these determinations alone. The specific gravity of genuine new milk seldom falls below 1·029, although it ranges from 1·028 to 1·032. At a temperature of 62° milk shows :

Specific Gravity.

	By Hydrometer.	By Weighing.	When Skimmed.
Pure Milk... ...	1·0320 ...	1·0314 ...	1·0337
10 per cent. water	1·0285 ...	1·0295 ...	1·0308
30 ,, ...	1·0235 ...	1·0233 ...	1·0248
40 ,, ...	1·0200 ...	1·0190 ...	1·0208
50 ,, ...	1·0170 ...	1·0163 ...	1·0175

Analysis shows the nutritive value of milk in comparison with medium beef, which is taken as 100, to be 23·8; or skimmed, 18·5; cream, 56·0; butter, 124·1; whole-milk cheese, 151·0; and cheese from milk with cream added, 103.

The work carried out by public analysts is very great; but their figures show that legislation is not yet perfect, and that adulteration is not decreasing. In the year 1880 the percentage of samples adulterated was 17·47; the number of milk samples purchased was 7251, showing a percentage of 40·40 which were submitted to the public analysts; while the 892 samples of butter purchased showed only 4·97. Of these submitted cases 50·98

per cent. of milk and 5·73 of butter were found to be adulterated; and in every case the 1879 percentage was exceeded. In the Metropolitan district the percentage of milk adulterations was 26·46 of the cases examined, while butter showed 24·41. Again, of 4031 samples examined from 150 towns, 17·87 per cent. were found to be adulterated. Thus, milk showed 26·46, as in London, and butter 26·13; while the counties gave a percentage of 20·40 and 15·69 respectively. The whole country showed an adulteration of 22·00 per cent. of milk, and 20·08 of butter; the latter having gradually risen from 13·93. Thus, comparison shows that there is little to choose between Metropolitan and rural districts. Birmingham, Manchester, and Salford, among other towns, were conspicuous for adulterated samples; some of those in the last-named town having had 30 per cent. of water added. With regard to the results of adulteration to the public, the Local Government Board says in its report:

"If we assume that in London each person consumes only a pint of milk weekly, or, rather over half a quarter of a pint daily (and this, considering that over one-eighth of the entire population consists of children under five years of age, is probably a moderate estimate), the yearly consumption of the Metropolis alone will be found to amount to nearly 23,000,000 gallons, representing, at 5*d.* a quart, an expenditure not far short of £2,000,000 sterling. If nearly a quarter of this milk be adulterated with about 16 per cent. of added water (and this seems, from the analysts' reports, to be the average proportion), it follows (on the hypothesis that the samples analysed are fairly representative of the entire supply), that Londoners are paying between £70,000 and £80,000 a year for water sold under the name of milk."

Perhaps few cases of dairy experiments have shown the value of analysis in the same degree as that which Professor Cameron undertook at the Government Agricultural Institution, Glasnevin. The morning's and evening's milk of 42 good, well-fed stalled animals, thrice crossed with the Shorthorn breed, were each

analysed once, and the mixed milk of the whole was once examined. The first group comprised 18 cows, aged 4 to 5 years, giving 9¾ quarts; their morning milk giving 12·97 of solids, and their evening 13·58. The second group of 12, aged 8 to 9 years, and giving milk on the average, during their fifth month, yielded $10\frac{4}{5}$ quarts daily; showing morning solids of 13·39, and evening, 13·96. The richest milk was given by an old cow, while four of the youngest averaged 12·24 per cent. solids, and 11¼ quarts a day. The experiment showed that, as the period of lactation advances, the quality of the milk is increased, as is shown by the following table, in which the yield is also given according to the period the animal had been in milk:

Cows giving Milk.	Quarts per day.	Solids in morning.	Solids in evening.
Less than 1 month	13	12·700	13·210
1 to 2 months	11½	13·460	14·120
During 4 months	10½	12·196	13·456
During 8 to 10 months inclusive ...	$6\frac{4}{5}$	13·570	13·960

There was an eight hours' interval between each milking; while the morning's supply was invariably the largest, although the evening's was, in the majority of cases, the richest, averaging, in fact, 0·54 per cent., which was entirely due to a large proportion of fat. The mixed milk, however, gave ·56 per cent. more of solids than the morning's, including ·44 per cent. of fats. The result of this analysis shows that the milk of well-fed, well-housed cows in the last quarter of the year contains, when poorest—*i.e.*, in the morning—13·90 per cent. of solids, including 4·20 of fat. In 25 cases, however, the solids, minus fats, were less than 9 per cent., or below the analyst's standard; and yet, when mixed, the milk of above 8 cows would rise above this figure, as did the mixed milk of the 42 cows in question by 0·7 per cent., although the average of the 42 analyses only gave an excess of ·38 above this standard.

This experiment again would tend to show that the fat

standard should be at least 2·75 instead of 2·5. The morning's milk showed a maximum amount of fat of 5·40, and a minimum of 2·88, the evening gave 6·30 and 2·69, while the mixed milk showed 4·20 in the morning and 4·62 in the evening. Thus, while the solids fell below the standard in 25 instances, when estimated without the fats, yet in no single instance did the fats themselves fall so low as the Society's standard. The percentage of total solids varied from 11·44 to 15·50 in the morning's, and from 11·50 to 16·80 in the evening's milk. Professor Cameron believes that milk, on the average, contains more than 13 per cent. of solids. His method of analysis was as follows: 10 grammes of the milk were kept in a shallow capsule in the water-bath at 212° Fahrenheit until thoroughly desiccated. The residue showed the total amount of solid matter. The 10 grammes, dried and pulverised, were boiled in about 80 cubic centimetres of ether for several hours, an upright condenser being placed over the flask containing the ether to prevent a waste of the latter. The ether containing the milk fats in solution was filtered, a very small piece of filtering paper being used, into a light tarred flask. The ether was distilled off, and the last traces got rid of by passing a current of hot dry air through the flask and condenser. The flask and its fatty contents were then weighed. The amount of the ash was determined by igniting, at a low temperature, in a platinum dish the residue obtained by evaporating 10 grammes of the milk to dryness. In every instance the solids were determined by two independent experiments.

An ingenious Milk Table, prepared for Munster Dairy School, was exhibited at the Birmingham Dairy Show. It would be very valuable but for its inaccuracies; but, as we give it below, it will be necessary to rectify the errors.

The composition of cream is given as follows:

Water.	Fat.	Casein.	Albumen	Sugar.	Salines
77·30	15·45	3·20	0·20	3·15	0·70

100 parts should yield 17·80 of butter, 81·50 of buttermilk, and 0·70 of loss.

The 17·80 of butter contains:

Water.	Fat.	Casein.	Albumen.	Sugar.	Salines.
2·55	14·60	0·35	0·05	0·05	0·10

The 81·50 parts of buttermilk yields:

Water.	Fat.	Casein.	Albumen.	Sugar.	Salines.
74·15	0·65	2·85	0·15	3·10	0·60

Milk contains in 500 parts:

Water.	Fat.	Casein.	Albumen.	Sugar.	Salines.
438·00	19·90	15·10	2·00	21·50	3·50

500 parts of milk yield 100 cream, 398·50 of skim, and 1·50 loss.

The 398·50 of skim contains:

Water.	Fat.	Casein.	Albumen.	Sugar.	Salines.
360·00	4·00	11·55	1·80	18·35	2·80

398·50 of skim-milk yield 39·65 cheese, 357·25 cheese-milk, and 1·00 loss.

The 39·65 of cheese contains:

Water.	Fat.	Casein.	Albumen.	Sugar.	Salines.
23·50	2·55	9·60	1·40	2·00	0·60

The 357·25 of cheese-milk contains:

Water.	Fat.	Casein.	Albumen.	Sugar.	Salines.
335·80	1·25	1·45	0·35	16·25	2·15

It will be seen that 100 parts of cream are supposed to give 17·80 parts of butter, or nearly one-fifth; whereas it is generally accepted that 2 lbs. 9 ozs. of cream will produce 1 lb. of butter in summer, to 3 lbs. in winter, under the ordinary systems. The Separator and the Cooley and Swartz systems make less butter

to the pound of cream, which contains more milk. There is, however, no standard, or anything approaching it; for on the one hand, we have known cows give 20 to 25 per cent. of cream, although their fats only averaged 4 to 5 per cent., while, on the other hand, cows giving only 12 per cent of cream, have averaged 5 to 6 of fat. Because a cow gives a large quantity of cream, it is not an absolute test of her butter value; neither is it correct that 500 parts of milk give 100 parts, or one-fifth, of cream. Very few cows give so much; indeed, of the 31 cows competing for the milking prize at the Agricultural Hall in 1879 and 1880, all presumably good animals, only 4 reached this standard. On the contrary, 8 gave less than 10·0, the majority giving from 11·0 to 12·0, and we should therefore say that 12·5, or one-eighth, would be a more correct estimate, this quantity making what is equivalent to about 5 per cent. of butter from the milk. Some persons consider 10 per cent. of cream to be a remarkably good average.

The analysis of skim-milk cheese, too, is at variance with that of Letheby, who gives 44 of water and 44½ per cent. of nitrogenous substances.

In all cases in which figures of this nature are published, something should be said to indicate the variable nature of the products of the cow, in order that persons who are not skilled in the subject may not go away with the idea that they are determined and fixed. While the fat and curd values vary with the breed of cow, and to some extent in different specimens of the same breed, the cream value varies immensely—so much so that it is impossible to say that so much cream should yield so much butter, or so much milk should yield so much cream.

The constituents of milk are, as shown previously, water, fatty matter, sugar, casein, and various salts. The fat we have fully described in the chapter upon butter. The sugar is a variety peculiar to milk; its chemical symbol is $C_{12}\ H_{22}\ O_{11}\ H_2\ O$, and it is termed lactoze. Casein, the nitrogenous principle to which

the feeding properties of milk are mainly due, consists, according to Mr. Watson, of about:

53·7	Carbon.
15·7	Nitrogen.
7·2	Hydrogen.
23·4	Oxygen.
100·0	

The apparatus required in making an ordinary analysis of milk is very simple—a pretty accurate balance with weights, a few small dishes (preferably made of platinum), a water-bath, and a small pipette.

1. Determination of Water and Milk Solids.—After carefully balancing one of the small dishes, weigh into the same a quantity of the milk which you wish to analyse—100 grains will be found a convenient quantity. The dish and contents are now to be placed on the water-bath; when the evaporation has ceased and the residue is dry, but before it has become discoloured by heat, the dish and solids are weighed, and the weight of the dish subtracted from the total weight, leaves the amount of solids, and by subtracting this amount from the total weight of milk taken we arrive at the water evaporated.

Example:

Weight of dish and solids	115·2 grains.	
Weight of dish alone	102·5 ,,	
Weight of solids	12·7 ,,	
Quantity of milk taken	100 grains.	
Quantity of solids	12·7 ,,	
	87·3 ,,	water.

2. Determination of Fats.—The milk solids contained in the dish are carefully detached from the sides of the dish, and reduced to a coarse powder; a small quantity (about 50 gr. measure) of ether is added, and the whole agitated and gently heated. It is allowed to stand for a few minutes, after which the ethereal solution is gently poured off, care being taken not to pour off

with it any of the undissolved matter. This digesting with ether is repeated several times (Mr. Watson generally finds three times to be sufficient), until the operator feels confident that the whole of the fat is dissolved. The ethereal solution thus obtained is evaporated in a balanced dish, the residue remaining being the fat in the quantity of the milk taken. The portion undissolved by the ether should also be dried and weighed, and its weight, subtracted from the total solids, represents the fat dissolved, and should agree with the fat obtained.

Example:

Weight of total solids	12·7
Weight of solids after treatment with ether	8·7
Fat dissolved	4·0

3. Determination of the Sugar.—The remaining portion—that undissolved by the ether in the last experiment—is treated with three or four portions of alcohol. The alcoholic solution thus obtained is evaporated, and the residue weighed, this consisting of the "milk-sugar" together with a little saline matter, also dissolved by the alcohol. This residue is now ignited, and the loss noted and subtracted from the total residue, which gives the amount of sugar, the difference being saline matter. The remaining undissolved matter, *i.e.*, matter undissolved by either ether or alcohol—should also be dried and weighed, and the loss noted.

4. Determination of the Casein and Salts.—The total residue remaining from Experiment 3 is submitted to ignition; the weight of the remaining white ash is subtracted from the total quantity ignited, which gives the casein, and the remainder the salts.

To the amount of ash here obtained, should be added that portion dissolved by the alcohol along with the sugar in Experiment 3.

In some cases it may be desirable to take the specific gravity of a sample of milk. This is most easily effected as follows:

Take a small bottle with a well-fitting stopper, which you know to hold a given weight of pure water; balance and add the number of grains which represent the weight of the water required to fill the bottle. Now fill the bottle with the milk under examination, and again balance and note the number of grains which the bottle has become heavier. Thus:

Weight of bottle	1000 grains.
Weight of water required to fill bottle	560 ,,
Weight of bottle when full of water	1560 ,,
Weight of bottle when full of milk ...	1577·47 grains.
,, ,, ,, water ...	1560·00 ,,
Increase	17·47 grains.

Then 560 : 17·47 :: 1000 : 30·5=1·0305 sp. gr. of the milk.

In most cases it is sufficient to determine the total solids, and solids minus the fat, when adulteration is suspected; the above notes may therefore be found serviceable in the practical analysis of milk.

In endeavouring to fix upon a standard for genuine milk, and which might be fairly deducible from the foregoing experimental results, Mr. Watson is of opinion that, taking large dairies, where the produce of a number of cows can be thrown together, so as to equalise the rich and the poor milk, and yield an average, the following proportions may be taken as a standard for genuine or normal milk:

Specific gravity	about	1·030
Cream	not under	6 per cent.
Total solids	,,	11 ,,
Solids not fat	,,	9 ,,
Fat	,,	2 ,,
Ash in solids	,,	0·65 ,,

As we have elsewhere mentioned, it is well known that the first milk drawn from the cow is the poorest in cream, and the last the richest. An instance of this will show how important it is to fully appreciate it. Lord Braybrooke, who won the £50

Challenge Cup, in 1882, for the best dairy record, showed the following results as the mean of six days' testing of 11 Jersey cows :

PERCENTAGE OF CREAM.

	First half-pint.	Last half-pint.	Entire yield.
Cow No. 1	5·8	33·5	15·5
,, 2	4·7	26·2	14·4
,, 3	4·5	23·6	12·0
,, 4	5·4	36·0	18·7
,, 5	10·0	34·8	18·4
,, 6	8·2	40·1	15·8
,, 7	7·1	36·0	15·2
,, 8	5·3	32·8	15·3
,, 9	3·7	40·0	15·1
,, 10	6·1	25·8	13·8
,, 11	5·9	26·5	12·5

Dr. Schlübler says that:

The 1st glass	of milk gives	5 per cent.	of cream at	1·0340	specific gravity.
,, 2nd	,,	8	,,	1·0334	,,
,, 3rd	,,	$11\frac{5}{10}$	,,	1·0327	,,
,, 4th	,,	$13\frac{5}{10}$	,,	1·0315	,,
,, 5th	,,	$17\frac{5}{10}$	,,	1·0290	,,
Or a mean of ...	...	$11\frac{5}{10}$	,,	1·0321	,,

Boussingault found in the first milk 2 per cent., and in the last 9 per cent. of fat; while Ramussen's experiments show 7 per cent. of fat in the first half, and 14 per cent. in the second half of a milking.

Dr. Paul Vieth, to whom the whole scientific dairy world is indebted, gives us his opinion that the only reliable tests which can be employed in a dairy are:

1. Taking specific gravity, by means of a good lactometer.

2. Taking the specific gravity of skim-milk.

3. Ascertaining the fat percentage by means of the lactobutyrometer, which is easily worked and gives results near enough to the truth, and

4. Soxhlet's Aerometric Process, which is more troublesome, but gives quite correct results.

Soxhlet's System.—Putting aside the actual analysis of milk, there is no system for the determination of fat which is so complete and so reliable as that known as the Aerometric System of Dr. Soxhlet, Director of the Agricultural Experimental Station at Munich. Instead of measuring the actual quantity of the fat in milk, Soxhlet gauges its specific gravity in solution, and by means of a table which he has drawn up the percentage of fat is shown immediately the specific gravity is taken. Large numbers of experiments were made by Dr. Soxhlet upon milk of a variety of kinds, and in fifty of those which he has published and in which milk was tested both by the gravi-metric and his own systems, the outside difference was in no one instance more than ·07, which is saying a great deal. Unfortunately the system is too delicate for an ordinary person to work; but it is nevertheless a very beautiful one, and will be much used in the hands of numbers of people who, by education, are equally as able to master its by no means difficult details as to manage a dairy-farm. The principle of the system is as follows:

Certain quantities of milk, ether, and a solution of caustic potash are mixed together, and after standing for a short time in water of a specified temperature, a portion of the ether with the fat in solution rises to the top, when its specific gravity is ascertained. The apparatus used are as follows: three pipettes, a small one to hold 10 cubic centimetres of caustic potash, a larger one made to hold 60 c. c. of ether, and one holding 200 c. c. of milk, all of which are shown in the illustration upon the three-footed stand where they are placed for safety. On the left of the stand is seen a glass tube with four outlets, one at the top, which is corked, a second at the bottom, to which is attached an india-rubber pipe, and two others, right and left, to which tubing is also attached. Within this glass tube is a smaller one which can be withdrawn at will, and in this is placed the aerometer, a delicate instrument upon which a tiny thermometer is fixed. It is this inner tube into which the solution of ether and fat is

pumped so that the aerometer will float and test its gravity; but as it is necessary, in order to do this accurately, that the temperature should be as exact as possible, the outer tube is filled with water of the required temperature, by means of the right-hand and left-

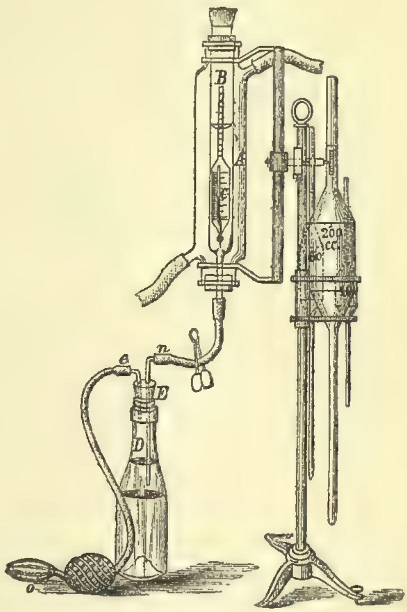


Fig. 1. Soxhlet's Apparatus.

hand pipes, and when full, a junction is made between these two pipes by means of a small piece of glass and some rubber tubing. The milk being well mixed, the required quantity is passed into a bottle of 300 c. c. capacity by means of the large pipette. To this is added the caustic potash and the ether, all three liquids being of the temperature of 17·5° Centigrade, or about 63½° Fahrenheit. The caustic potash must be of 1·26 to 1·27 specific gravity, and can be obtained of any good chemist, or may be

prepared by dissolving 400 grammes of fused caustic potash in half-a-litre of water, which is made up to one litre after cooling; or, 400 grammes of caustic potash may be dissolved in 870 grammes of water. The ether used is commercial ether, but it must be saturated with water to the extent of from $\frac{1}{10}$ to $\frac{2}{10}$ its volume. The mixture in the bottle is now corked and violently shaken for half-a-minute, then placed in a vessel or bath containing water of the same temperature, 17·5° Centigrade, for a similar period, and it is continued to be shaken every alternate half-minute for a quarter of an hour, after which it is stood in the bath for a quarter of an hour longer, when the solution of fat and ether will be seen at the top. Sometimes, however, it happens that the solution is a long time collecting, more especially when the milk is from stale cows. It is now necessary to change the cork for one in which are two glass tubes, each having two branches at right angles; these tubes are attached, one to the india-rubber pipe fixed to the aerometer tube, and the other to a tube attached to small india-rubber hand bellows. A portion of the ethereal solution is then pumped up into the inner tube in which the aerometer stands, and when it floats a small pair of nippers are fixed on to the tube, and the experiment is over. The specific gravity is now read off, and corrected if the temperature is not exactly what it should be, when, by reference to Soxhlet's table, the percentage of fat can be ascertained. With the apparatus, which is made by Greiner, of Munich, full

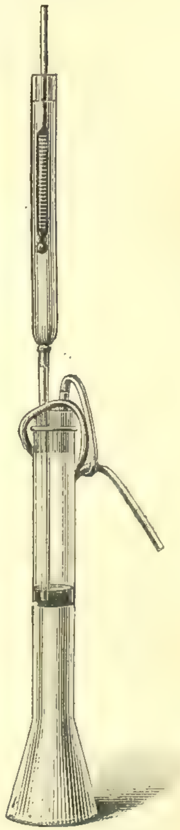


Fig. 2. Dr. Bond's Modification of Soxhlet's Apparatus.

instructions (in German) are sent. Two aerometers are used, the one for new and the other for skim-milk.

Dr. Bond has somewhat simplified the performance of Soxhlet's test, and reduced the cost of the apparatus by adapting the bottle in which the milk is agitated with the ether and potash, so that the ethereal solution of fat, when it is formed, can be blown directly into the tube that holds the aerometer, which is fixed by a simple arrangement in the cork of the bottle. The whole appliance therefore consists only of a long-necked bottle, an india-rubber cork, with two glass tubes in it, one to which a piece of india-rubber tube is attached, for blowing purposes, and the other with an india-rubber collar on the top which receives the stem of the tube for holding the aerometer, and with the lower end dipping into the ethereal solution of butter-fat. On blowing gently through the india-rubber tube the ethereal solution is blown up into the aerometer tube, where the reading is taken precisely as in the case of Soxhlet's arrangement. The necessity for the adjustment of the temperature of the apparatus to the standard of 17·5° Centigrade is met by a simple form of bath, which is supplied with it; but where the temperature of the air is only a few degrees below this point, that of the ethereal solution in the aerometer tube can be easily brought up to the requisite degree by applying the warm hand to the tube. Dr. Bond states that in this way, with a little care, as accurate results can be obtained as by the more elaborate apparatus of Soxhlet.

One of the most popular systems of ascertaining the butter-value of milk is that known as Marchand's *Butyrometer*. This is so simple, and can be so easily manipulated by any person of ordinary intelligence, that we cannot too strongly advise its adoption by dairy-farmers, more especially as its cost is not great, although strangely the apparatus is more expensive in this country than in Germany. The articles used are a glass tube, divided into three parts and provided with a scale at the top for the estimation of the percentage of fat, a metal bath almost as

deep as the length of the tubes, ether, alcohol, and caustic potash. Greiner, of Munich, sends out a complete set of tubes in the form illustrated in the accompanying engraving. In this case, the bath

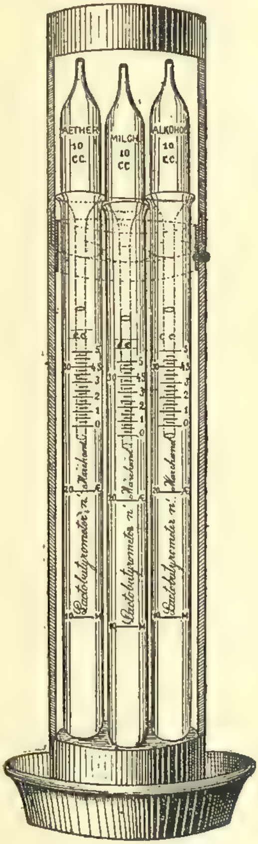


Fig. 3. Greiner's Lactobutyrometer, Bath, and Pipettes.

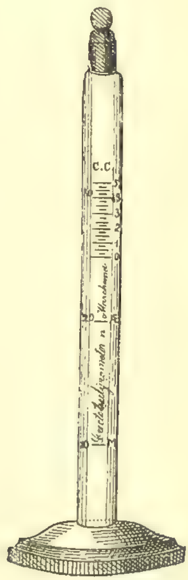


Fig. 4. Lactobutyrometer on stand.

is of brass with a tray at the bottom for spirit; it is provided with a cap which, when taken off, exposes the three tubes which the bath holds. In the engraving three pipettes are also shown packed within the tubes for convenience. The manipulation is

as follows: The milk having been well mixed, the milk-pipette is filled and emptied into a tube, and should reach the line marked upon it showing the exact quantity necessary; a similar quantity of ether is then drawn into another pipette and also discharged into the tube, reaching the second division or line. The mixture is then violently shaken for two or three minutes until it has thoroughly combined, and no ether rises to the top. Lastly, a like quantity of alcohol is taken in the third pipette and also mixed with the ether and milk in a similar manner. When this is done, two or three drops of caustic potash having been added, the tube is corked and placed in the bath, which must be provided with water at a temperature of 104° Fahrenheit. Several tubes can be placed in the same bath, and the fat will at once be seen rising. In a few minutes, when all has risen, it can be measured off upon the scale with the eye, and will give the percentage in the milk. This system cannot of course compare with analysis, but it is nevertheless a valuable one and approximately correct.

Storch's Fat-extracting Battery.—At the Royal Agricultural Laboratory at Copenhagen in 1883, we were shown by Professor Storch an elaborate system which he had invented for the extraction of fat from milk, cheese, etc., and which had yielded highly satisfactory results. It is not adapted for any but scientific purposes, but deserves a place in this chapter, and we have to thank Mr. Scbelien, the chief assistant at the Laboratory, for drawings which have enabled us to present the accompanying illustrations. The apparatus consists of a round table with a circular cold-water bath fixed in it, level with the top, round the centre of which a steam pipe is laid in order to heat the distilled water to 96°, the boiling-point of ether. This distilled water is immediately above the cold water in a separate compartment of the bath, and in it are placed, at equal distances apart, 15 flasks, narrow at the top and increasing in width to the bottom, which contain the ether used in the experiment. In each flask is placed a conical glass tube, the narrow end of which is connected with

the flask by means of a tight cork. The bottom end of the tube extends a little below the cork, and is furnished with a cork of

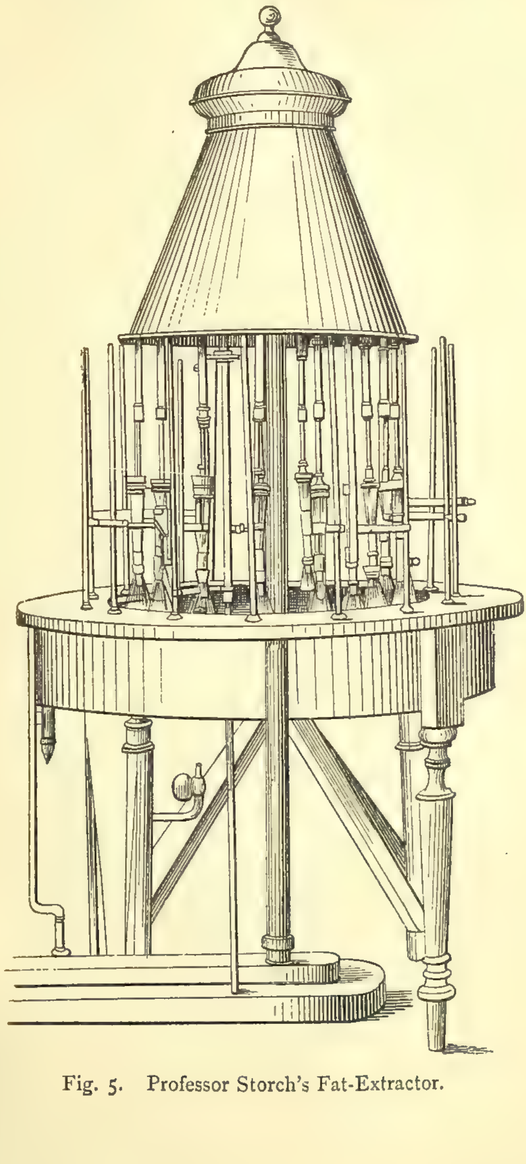


Fig. 5. Professor Storch's Fat-Extractor.

hard-pressed cotton-wool. Through this a narrower tube passes to a short distance below the cotton-wool cork and nearly as high as the conical glass tube itself. In the conical tube (on the cotton-wool and surrounding the small tube) is placed the substance which has to be examined. At the upper end it is provided with a brass ring which is furnished at its exterior with the worm of a screw, so that a brass cap may be screwed on and the tube made air-tight. Through the centre of the cap passes a short tinned brass tube, the bottom of which is a little below the top of the narrow tube before mentioned, the upper part projecting only a very small distance, and being screw-cut at the top inside for the purpose of its being connected with a narrow tinned tube above. This last-named tube extends half-way up a wider one of brass, the latter being at its lower end, and a short distance from the bottom of the tinned tube, connected with a brass stopper well packed with cork for the purpose of making it air-tight. The top part of the narrow tube ends in a tight-fitting cork packing, while the surrounding tube at the upper end is continued upwards by a narrower one made of crown-tin, this entering a copper cooling hat in which cold water circulates. When all the tubes are properly fixed, each conical tube is held in its position by a clip made for the purpose, these clips being attached to uprights placed in the table near the bath. During the experiment the vapour from the ether escapes from the flask below into the conical tube above, and, after condensing and dissolving the fatty substance, falls down upon the mass which is undergoing examination, soaks it, and returns through the cotton-wool back into the flask, the ethereal solution of fat weighing about 20 to 30 grammes. If the ether vapour is not all distilled in the conical tube, it will be on reaching the tube in the copper hat (providing it has not been distilled in any of the intervening tubes), when it will descend into the flask as before. The experiment being finished, all the ether is evaporated from the flask, the latter is

dried at 101° to 102° Centigrade and weighed. The process is continued until two successive weighings show the same result, which is not a difficult task as regards milk when the latter is dried (10 cubic centimetres) on pulverised pumice-stone at 102° Centigrade and pulverised to dust. In experimenting, however, with cheese the difficulties are greater.

Spinks' System.—In June, 1883, Mr. C. A. Spinks very kindly

Fig. 6. Flask and Conical Tube.

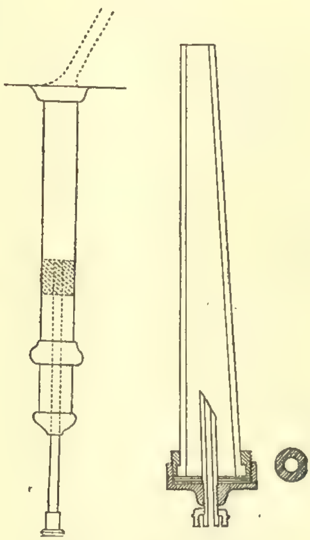


Fig. 7. Metal Tubes.

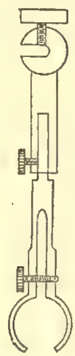


Fig. 8. Clip.

sent us the following particulars of his method of ascertaining the quality of milk by means of the lactometer and the *burette*, which at once commends itself as simple and effectual, for the result wholly depends upon the specific gravity of the new milk, the cream, and the skim-milk. In describing his system, Mr. Spinks says that

"as the quality of cream depends on the proportion of butter-fat it contains, and as this fat has a very much lower specific gravity than even water, it follows that the richer the cream, the lower its gravity will be, and, *vice versâ,* the more watery the fluid containing solids, not fat, in the cream, the higher its gravity will be. Thus, when the specific gravity of any cream is known, its quality can be judged with correctness for all practical purposes required by the dairy-farmer. The remaining part, or skim-milk, may also be judged by its gravity; but this, contrary to cream, is better the higher its gravity. There are several ways of ascertaining the specific gravity of cream, but the following method I have found most satisfactory. A sample of milk is obtained, and its gravity ascertained with the specific gravity lactometer. The milk is then poured into a large percentage glass or *burette*, having a tap or plug in its bottom. The sample is allowed to stand as usual for 24 hours, after which time the percentage of cream that has risen is read carefully off. The remaining milk from which the cream has risen is then let out into a clean trial-glass, taking care to let out every drop of skim-milk, but not a drop of the cream read off. Stir thoroughly and ascertain the gravity of this skim-milk with the lactometer. To obtain the specific gravity of the cream, multiply the two volumes of milk by their respective specific gravities, and divide the difference of the products by the difference of the two volumes. The result will be the specific gravity required to be found. The volume of milk in the *burette* being taken as 100, the volume of skim-milk will be 100 less the percentage of cream. It is convenient to take the specific gravity of water as 1000. The lactometer scales, commencing at 0, and generally extending to 50, will then show the excess gravity over water, which, added to 1000, will give the specific gravity; and the specific gravity of the fluid so expressed, when divided by 100, will represent the weight of one gallon of such fluid. For example, supposing the specific gravity of the milk

to be 1030, and when skimmed, 1036, the percentage of cream being 12,

$$\begin{array}{rr} & \text{Then } 100 \times 1030 = 103{,}000 \\ [100-12=88] & 88 \times 1036 = \underline{91{,}168} \\ & 11{,}832 \div 12 = 986 \end{array}$$

the specific gravity of the cream.

"Of course, when comparing individual cows with each other, the average yield must be considered, also each one thoroughly milked, and the cream properly diffused throughout, before taking a sample."

As the lactometer plays an important part in this test, Mr. Spinks explains that the instrument with a fixed scale cannot be corrected except for milk of a particular gravity which has been adjusted to the line at the bottom of the scale; and he states that, having constructed a lactometer to show the quantity of water added to one gallon of pure milk, he found that it was no more correct than instruments already in use. He chose a specific gravity of 1028 to which to adjust his scale, so that milk of 1032, for instance, would permit of the addition of a considerable quantity of water before registering the fact that it had been watered. If it is necessary to test the lactometer, the following method will be found valuable, but its accuracy absolutely depends upon the quantities being correctly measured and weighed. Dissolve 3 ozs. 51 grs. of perfectly dry loaf sugar in pure water up to one-and-a-half pints. This may be done by taking a sufficiently large bottle and marking on opposite sides the line to which this quantity of water reaches. Put the sugar into the empty bottle, and pour about a pint of boiling water over it, and, when thoroughly dissolved, reduce the temperature to 60° Fahrenheit; then add water at the same temperature until the marks on the bottle are reached, and mix thoroughly. There will now be one-and-a-half pints of this solution at a temperature of 60° Fahrenheit, and its specific gravity

will be 1040 exactly. The table below shows in the first column the proportions of the solution and water necessary to be mixed to give the specific gravities stated in the second column:

SOLUTION OF DRY LOAF SUGAR, 3 OZS. 51 GRS., DISSOLVED IN PURE WATER UP TO $1\frac{1}{2}$ PINTS.

Parts of Water.		Parts of Solution.		Sp. Gravity at 60° Fahr.	Parts of Water.		Parts of Solution.		Sp. Gravity at 60° Fahr.
8	to	0	...	1000	3	to	5	...	1025
7	,,	1	...	1005	2	,,	6	...	1030
6	,,	2	...	1010	1	,,	7	...	1035
5	,,	3	...	1015	0	,,	8	...	1040
4	,,	4	...	1020					

The lactometer is tested in each solution, and, if correct, the specific gravity indications of the instrument will agree with the respective gravities of the solutions in which it is tried, remembering that the readings of the lactometer are excess gravities over 1000, or water.

Mr. Spinks has also constructed a very clever lactometer table for showing milk adulteration. He states that it was designed especially for the use of town dairymen in detecting the watering of their milk by servants whilst serving it upon their rounds. In the first place the specific gravity of the new milk is ascertained by the farmer, or whoever despatches it, and this is checked by the dairyman who receives it, so that if each person has an instrument equally adjusted, it will check watering during transit. The milk is then presumably despatched upon the rounds, and that returned is again tested with the lactometer, so that any watering, together with the amount of the water, is at once detected by a difference in the specific gravity. Inasmuch as the density of skim-milk varies much less than that of new milk, it is a remarkably reliable guide in the detection of adulteration. Thus, far more accurate results would be obtained from testing samples of milk which have been skimmed, each having stood, say, 12 hours at the same temperature, in order to check the

imperfect diffusion of the cream whilst the milk was being sent upon the rounds.

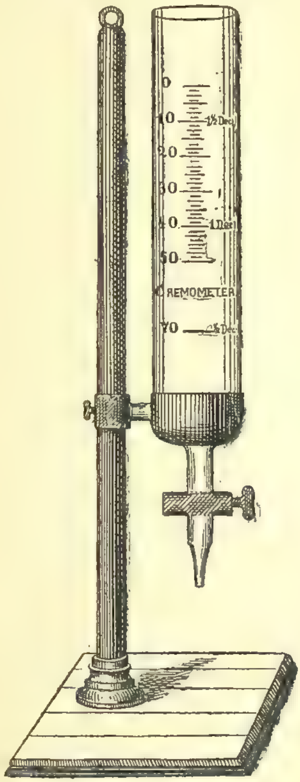
Milk Testers are not particularly numerous; indeed, it is questionable whether an absolutely perfect instrument can be devised, inasmuch as specific gravity, as well as the cream test, has proved inefficient, when used alone. The use of the lactometer, creamometer, and thermometer in combination, however, are found to be very sure tests, and although in cases of prosecution analysis is resorted to, yet in private practice the above will answer every purpose.

The *Lactometer* ("*Lactodensimètre*" of the Continent, also called an *Éprouvette*), is used for gauging the density of milk. It was invented, we believe, by M. Quevenne, a medical man in Paris, and is now in general use, although the scale differs in various countries. It is similar to an ordinary hydrometer, and is furnished with a scale which shows the density of the milk at a glance.

A given volume of water, weighing 1000 lbs., is no larger in bulk than a similar volume of milk weighing 1029 to 1033 lbs., according to its quality; and bearing this in mind, Quevenne, taking off the 10, used the other two figures upon his lactometer. His scale commences at 14, which is at the top, and descends to 42, at the bottom. It is apparent that 14 (otherwise 1014) is far too low, and that 42 (1042) is just as much too high to be necessary in ordinary practice; but the margins were designed to show the extent of adulteration in both new and skimmed milk. Modern Continental lactometers, however, have only a scale from 25 to 35, which is generally all that is found necessary. When the instrument is placed in the milk—which it should be very gently, in order that it may not sink, and cause milk to adhere to a point above that at which it floats, or it will not be true—the figure which is level with the surface will show the true state of the case. Thus, in Quevenne's, if it rests between 29 and 33, it is pure; if between 27 and 29, $\frac{1}{10}$th water has been added; 24 and 26, $\frac{2}{10}$ths; 21

and 23, $\frac{3}{10}$ths; 18 and 20, $\frac{4}{10}$ths; 15 and 17, one-half; and so on. With English lactometers the scale commences at the bottom, at 10, goes up to 0, and then up to 100, at the top. Pure milk marks 0, pure water 100, thus every figure between shows the actual adulteration; the 10 spaces below 0 indicating when milk has been skimmed. These lactometers are usually employed in milk heated to 60° Fahrenheit, while the Quevenne is used at 59° Fahrenheit (15° Centigrade, and 12° Réaumur). An advantage of Quevenne's scale is that it tests skimmed milk as well as whole milk, the same figures being made to apply, by being bracketed; thus 33 to 36 indicate purity—skim-milk is heavier than new milk, the lightest portion, cream, being skimmed from it—while the addition of water is shown between 32 and 17. There is no doubt that Quevenne's instrument acts well when used for mixed milk, but it often varies considerably with the pure milks of individual cows. In using the lactometer, it is necessary to have a deep and narrow glass vessel similar to a creamometer, in which the milk is poured at the right temperature. When the instrument is placed in the milk, it must be held by the stem until it floats at the right mark, that it may not become too heavy as mentioned above. If it sinks below the pure milk mark, the percentage of watering may be suspected. Thus, supposing the lactometer be an English one, measuring 0 to 100, if one-half the liquid be water and the other half milk, it will sink to 50; if 20 per cent. of water is added, it will sink to 20, and so on. Supposing, however, that the milk has been skimmed, it sometimes passes the point at which pure milk is denoted. It must be remembered that the lactometer cannot be expected to do more than it professes. It denotes the gravity of milk, and if that gravity is anywhere near the average, all well and good; but as, unlike water, the milk of different cows varies in gravity, so does the instrument cease to be a specific guide when applied to these distinct samples. If in testing a sample it is found lighter than the average, there is reasonable suspicion that it has

been watered; if, on the contrary, it is found heavier, there is ground for believing it has been skimmed. The English lactometer shows this on the scale 10 to 0. It has been pointed out very truthfully—we forget by whom—that inasmuch as



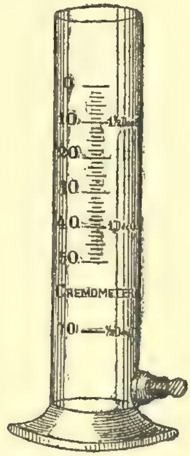


Fig. 9. German Creamometer. Fig. 10. Creamometer with Tap.

cream, like water, is lighter than milk, a sample heavy in cream would appear to be adulterated, just as though it had been watered; while, on the other hand, if salt or sugar were dissolved in the milk, they, being heavier, would cause it to show that to all appearance the milk had been skimmed. Thus it is always well

to use the creamometer and lactometer in conjunction with each other, so that when both point to watering or skimming, there is little doubt of the fact. We have shown that if water is added to milk it is made lighter, and that, if skimmed, it becomes heavier from the loss of its lightest constituent; therefore it is possible to first skim it, and then bring it back to its normal gravity by the addition of water. Although the lactometer would not detect this, the creamometer would, but no purchaser could be cheated by such a palpable fraud. The best English lactometer is *Barham's*.

The *Creamometer* is a cylindrical instrument of glass, standing upon a foot. It has a scale marked upon it which is divided into a given number of parts. It was found by Chevalier, by experiment, that the value of the glass creamometer is much regulated by its diameter being in accordance with its height. In using it, the milk is poured in until it reaches the top line 0, and left for 24 hours in a room at about 60°, by which time it will have formed a cream of 7° to 25°, according to its richness; we have, however, seen it less than 7° and more than 25°. This instrument is valuable, as shown above, for use in conjunction with the lactometer; and also for testing the cream yield of individual cows, at all times and on all foods. It is of course not pretended that the quality of cream is shown by the creamometer, for cows giving the same quantity often make less butter than others. At the same time the cream test by this plan is a very valuable one.

A *Lactoscope* has recently been invented by Professor Feser, of Munich, which is based upon the measurement of the degree of transparency of milk, which depends on the contents of fat. The instrument consists of a graduated tube, marked with a double scale, and a pipette which is filled with the milk to be tested. The milk is poured from the pipette into the large tube, and water is added until the black lines are visible, when the percentage of fat will be shown. The lactoscope is a very ingenious

instrument, but it is not perfect. We saw it in use at the Cham Laboratory, Switzerland, where the chemist had made a more exact instrument after Feser's model.

Dr. Bond, of Gloucester, has applied the optical test for the examination of milk in a manner somewhat analogous to that adopted by Feser in his lactoscope, but in a way which is adapted to give more accurate results. Dr. Bond's lactoscope consists of a circular glass dish, on the under surface of the bottom of which is fixed a pattern, consisting of some parallel black lines, which are distinctly visible through the transparent bottom of the dish. To use the appliance, a measured quantity of water is poured into the dish, and the milk to be examined is dropped, from a dropper supplied with the instrument, into the water, which is stirred at intervals so as to mix the milk and water well together, until the eye ceases to be able to recognise the number of the lines in the pattern. The number of drops of milk required to produce this result is then referred to a table which accompanies the apparatus, and the percentage of butter-fat present in the milk is thus obtained.

Fig. 11.
Feser's Lactoscope.

This lactoscope, which has the advantage of being cheaper and less fragile than those of Feser and Vogel, is capable of giving equally good results, but, like all other lactoscopes, it is only trustworthy in comparatively fresh milk, since directly the milk begins to sour, and the casein to be coagulated, a serious source of error is introduced.

A German gentleman, Dr. Heeren, has invented an instrument which he calls a "*Pioskop*," from "Pios," fat. It consists of a small round disc of india-rubber, in the midst of which there is a circular raised ring and a glass disc of the same size, also

divided by a ring in the middle, the outer part of the disc being divided into 6 equal parts, and coloured from white into shades of blue up to dark blue; the white signifies *cream;* the light blue, *very fat;* medium blue, *normal;* a deeper shade, *less fat;* deep blue, *thin milk;* and blackish blue, *very thin.* In working, a few drops of milk are placed into the inner part of the india-rubber disc;

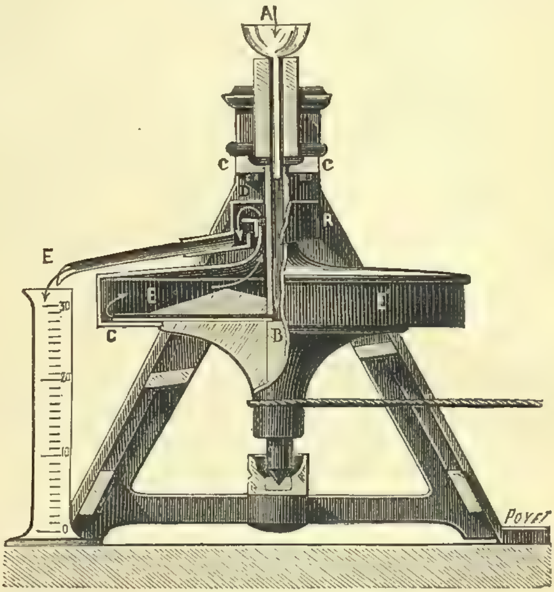


Fig. 12. Sourdat's Écrémeuse.

the glass disc is next placed on the top, so that the transparent part is on the top of the milk. The milk thus manipulated changes to one of the colours named above, and indicates its quality. The price of the *Pioskop* is 1*s.* 6*d.*, and it is sold by Beinbauer, of Hamburg.

M. Sourdat, of La Chapelle, Paris, has recently invented an "*Écrémeuse*" or Rotating Creamometer, which, by centrifugal force, shows the quantity of cream in milk. Its price, 100 francs,

is however higher than the public will care to give even for such an article. The instrument consists of a drum which turns upon a vertical axis, its interior diameter being about 6½ inches, height ¾ inch, and total capacity 117 cubic inches. The lower part of the drum is raised in the centre, to assist the ascension and dispersion of the cream. The milk to be dealt with is poured down a central tube by the aid of a funnel (A), whence it flows into two horizontal tubes, and from these into the drum (E′). A rapid circular movement is then given to the drum, by manual power, for five or ten minutes, the revolutions being about 2100 per minute, and the cream, gathering near the central column, is dispersed by pouring into the tube some fresh milk—$\frac{1}{18}$th of the total quantity in the drum. If possible, cream from a preceding operation is to be preferred. This new milk or cream, arriving near the periphery, forces the first milk towards the centre where the cream is, which, being condensed, is made to ascend and flow into a tube concentric with the axis, and thence into a larger surrounding tube or receptacle which is fixed. From this it runs away into a narrow *éprouvette* (E) or graduated glass tube. The first drops are very thick, becoming gradually more and more clear, until it is difficult to determine the moment when the cream ceases to flow and the skim-milk appears. In order to be able to make a comparison, a quantity is gathered in the *éprouvette*, equal to a capacity of about 11·8 cubic inches. The densities are then taken : *first*, of the cream, or of the above quantity, this being well mixed for the purpose; *second*, of the skim-milk remaining in the body of the *écrémeuse;* and, *third*, of the whole milk. The last-named is not absolutely necessary, but is useful for the purposes of comparison. The densities are taken by means of a very accurate balance. By this system, M. Sourdat says that cream having a density of 0·996 has been obtained in ten minutes, while under the ordinary system of natural rising the density was 1·016. It is necessary, however, to remark that great care must be exercised throughout each stage of the

operation, especially where comparative and consecutive tests are made of the same milks; indeed, it is only after a certain amount of practice that the results obtained may be depended upon.

An instrument called a "*Testing Centrifuge*," was recently invented by the Rev. H. Bond of Worcester, Mass. It is practically as correct in gauging the cream which is contained in milk, as the

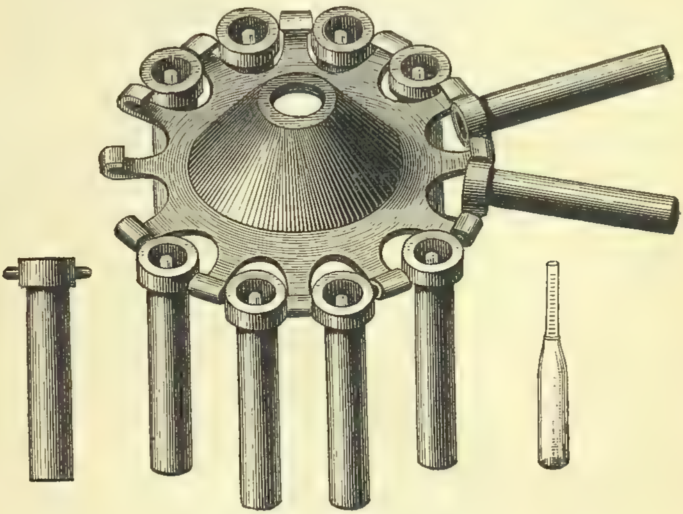


Fig. 13. Fjord's Control Apparatus.

creamometer; but, unlike the latter, it does its work at once, and more completely. It is also believed to be a better test of the available cream in milk than analysis, because the latter gives the total butter-fats, all of which have never yet been obtained by any practical method of cream separation.

An apparatus was recently patented by Mrs. Busby Fox, of Oxton, Cheshire, which is designed to skim, measure, and test milk. A bowl is fitted with a tube, both being graduated to measure the milk in the one, and the cream in the other. The tube is fitted into a rubber-washer at the bottom, and near this is a groove through which the milk can escape. When the milk in

the bowl is to be skimmed, the tube is screwed up, and it at once runs out from both bowl and tube, leaving the cream behind it. A lactometer is also supplied, which indicates the presence of water.

Fjord has invented a system by means of which a number of samples of milk can be tested at one time. Messrs. Petersen & Co., of Copenhagen, have specially adapted the idea to their Danish Separator, in which the apparatus is revolved, causing the cream to rise into the graduated neck of the bottles, when, owing to the speed of the machine, the swinging metal tubes in which they are placed fly into a horizontal position. This apparatus was awarded the Gold Medal at the Paris Exhibition of February, 1885

CHAPTER VII.

CREAM.

PROBABLY there are few individuals, young or old, who are able to appreciate what food is, who do not know something about cream. Yet we believe that the number of those who know that butter is made from cream bears an unfavourable comparison to the whole of the community; and, again, we may fairly assume that the number of persons who understand the nature of its constituents is diminished in a similar proportion. There are persons who do not like cream—who, in fact, have an aversion to it—but the vast majority of those whom one meets in every-day life are particularly partial to it in any form, so long as it is sweet, and would be very glad if it could be brought more easily within their reach. In only one part of England, so far as we know, is it a common article of sale, and in Devonshire and Cornwall it is to be found in the dairies in small quarter, half-pint, and pint mugs, as regularly as milk. Of course it should be explained that in these counties it is clotted, almost as thick as butter, and the mugs are covered with a piece of the yellow skim which forms on the top of the cream-pan. It has been asserted that clotted cream cannot be as successfully made in other counties, but we have found no difficulty in Hertfordshire, and we do not believe it need be apprehended in any other county. Customs have a great deal to do with the sale of any article, and in the above counties people of all positions regularly purchase their cream; thus, if it were the custom in other parts of England, there is no doubt that the

milk-sellers would be equal to the demand. At any rate, we believe that even now, an energetic dairyman, who systematically kept it for sale at a reasonable price, and made this fact known to his customers of the better class, would add a profitable and increasing branch to his business. As it is, the complaint of residents in the suburbs who can afford to buy, and gladly would buy cream, is that they cannot obtain it good, and that in any form it is a preposterous price. It should be worth the while of any farmer or milk-producer to attempt the supply of cream—certainly of clotted cream. With the aid of the separator he could send raw cream away the morning of milking, while without this grand invention he could send it within twelve hours after, so that on the score of sweetness no one need have any reason to complain. The milk-seller, too, in case of his supply at any time exceeding the sale, has his remedy in the churn, which will always convert it into butter, whereas the butter-milk would afford him an opportunity of establishing a trade with poorer persons, who, as a rule, in the populous parts of the north, where it is sold, are very partial to it.

With regard to the profit upon a sale of cream, as against milk and butter, a few words may be said. At the present time numbers of persons make butter, and utilise the skim-milk by pig-feeding, because of some difficulty in the way of selling the milk, which would be more profitable. The price of milk during summer is about 1*s.* 1*d.* to 1*s.* 2*d.* per barn gallon, or much less than 1*d.* per pint; although in winter it reaches 1¼*d.* The Aylesbury Condensed Milk Company, which purchases 4000 gallons daily from above 80 farmers, pays at the rate of 6*s.* 6*d.* per 100 lbs. in summer, and 8*s.* 4*d.* or 1*d.* per lb. in winter. These figures are equal to a little more than 7½*d.*, and a little less than 10*d.*, per imperial gallon. By way of illustration, it may be assumed that this imperial gallon would yield 1¼ lbs.—that is, about 1 pint of cream. Cows vary in the quality of their milk as in their quantity, and analyses do the same, but 12½ per cent. may be

considered a high average, and one seldom reached in large dairies. The table we have quoted fixes the percentage of butter from cream at 17·80; consequently, if we accept 20 ozs. as a fair estimate, we have 3·56 ozs. of butter, or little more than 2 per cent. of the milk, although the Munster table gives us 3½ per cent. The result is, that the imperial gallon is worth in summer 6½*d.*, against 3½*d.* for the butter; and it only remains for producers to estimate, according to their yield and other circumstances, whether they can make more than 8*d.* for the cream, for it is certain that they could do infinitely better with it than by making butter, even if we allow an ample sum for the buttermilk and skim-milk. In London, cream can seldom be purchased at less than 2*s.* the pint, and in some quarters it is much more, and yet there is no doubt that the producer in the country would be glad to supply a much better quality at half the money.

In clotting cream we have adopted two systems, setting the milk to scald, as it comes from the cow, and setting at the end of 24 hours, and we cannot say that we found much difference. In some cases, the pans stood in hot water; in others, directly on the hot plate. Greater facility was found in pouring the milk into the pans as they stood ready over the fire, than in removing them from the dairy, a practice which, with a full pan, is always attended with spilling. There is one great advantage in scalding the milk—it must never be allowed to boil*—when, from any unknown cause, the cream has made a practice of taking a long time to change into butter, the annoyance may be prevented in future by this plan. The milk may be heated up to 160° or 170°—every

* Supposing, however, that it should happen to boil, a little cold water should be immediately poured in to check it, and the pan lifted off the fire. In this case, the butter will not be so good; it will be without flavour and rough to the tongue, and it need scarcely be added that it should not be mixed with perfect butter. There is one thing to remember in scalding; that, if the milk is *at all* sour, even in a slight degree, heat will make matters worse, and curds and whey will be the result. Hence the great advantage of scalding immediately after milking in hot or thundery weather.

dairy should be provided with a thermometer—in which case the cream will be thick or clotted, and churn into butter within a few minutes.

The specific gravity of cream is about ·985, while milk is about 1·030, and water 1·000; and the cause of the cream rising to the surface of the milk is that its gravity is not only less than that of the milk, but of the water in the milk. It is worth the while of those who take any interest in the various systems of milk-setting, and do not understand the reasons why excesses of temperature have such an effect upon the rising of cream, to make a few experiments for themselves. In the ordinary way, the cream may be made to rise faster by lightening its gravity. It is, as stated, lighter than the water of the milk; hence, if it is warmed it is made still lighter; for although the water is warmed at the same time, it cools sooner than the cream. This fact, simple when understood, is one of those little secrets which science has imparted to the dairying system, and which have done so much to rescue it from an old and ignorant school of men who still continue to oppose its teaching. Nothing has so much effect upon cream as temperature, for it also rises more quickly if it is cooled; hence the advantage of the deep-setting systems, which we have explained in another chapter. When the temperature is low, the cream is thin and heavy, when it is warm and dry it is thicker and stiffer, and often covered with a skin; and the longer it is allowed to stay on the milk the thicker it becomes. There is less difference in the gravity between milk and cream when the temperature is very low, and a greater difference when it is high; and the reason of this is, that although water contracts with cold and expands with heat, fat does the same, only in a greater degree. The result is obvious in the rising of the cream. If it is set to rise under the cold system, it will be thin, because it is mixed with a small proportion of milk; it is, in fact, not completely separated. Hence the system has been advocated by those who would raise cream for sale. If the raising is conducted under the ordinary system, in a warmer

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atmosphere, it will be thicker and purer; but it will take very much longer to rise, and the milk will often spoil in the process. And, lastly, if the "Devonshire" system is resorted to, it will be thickest of all.

Most people know that cream never rises well upon milk which has been shaken about a great deal; hence, London dairymen seldom set for cream, but, when they do, they do not obtain a large yield. If, however, they use the centrifugal machine for separation, they obtain almost all the cream the milk contains. When once skimmed, the cream will rise on the skim-milk much better if it is heated to 80°, and then set at a temperature of 45° to 50°.

It is generally accepted that, under the Cooley system of raising cream, 15 gallons will yield 3½ quarts in 12 hours, and that the separator will yield 16 to 17 per cent. in all from ordinary milk. The cream from 2½ gallons, or 25 lbs. 10 ozs. of really good milk, should yield 1 lb. of butter; although some cows do better than this, and a great many worse, ordinary cows' milk usually making 1 lb. of butter to 3 gallons.

Now that ice or iced water is so much used, where dairy work is conducted on a large scale, it may be remarked that Professor Arnold has pointed out the unwisdom of the practice of adding these to the cream, on account of the impurities and germs which they contain, and which, by developing, may have a great effect in spoiling butter which has been most carefully manufactured. Again, ice, when placed in cream, changes the temperature of that which immediately surrounds it much too quickly, and it breaks the grain of the globules of fat and affects their keeping.

Almost every one connected with the dairy knows what "sleepy" cream is, and those who do not will never forget it if they happen to have the misfortune to churn when the phenomenon occurs. The whole of the cream assumes the appearance of froth, and we have seen a large churnful spoiled more than once. During a fair experience of dairying, and close observation of

everything connected with it, we have never met with an individual who could give a satisfactory explanation of the cause of sleepy cream, nor have we ever met any one who could properly set it right. Managers of dairy exhibits at the exhibitions, experienced dairymen and dairy-farmers' wives, have alike admitted their ignorance upon this subject when we have broached it, and we are compelled to admit that it was not until a somewhat recent date, when we had a personal experience of it, through the ignorance of a new dairymaid, that we arrived at any definite knowledge on the subject.

In another chapter we have described the composition of butter. It is, in fact, an amalgam of fats, which, in their turn, consist of various acids in union with glycerine. When we say acids, we do not mean that they have a pungent taste, like a lemon; but they are acids from a chemist's point of view, because they possess the ability of uniting with an alkali. Thus, soap is a union between an alkali and fatty acids. Our object in making these remarks is to show the danger of cleaning dairy utensils, more especially a churn, with soap, or even soda; because, from what we have said, it will be seen that nothing is so liable to act upon the cream, or the fatty acids in the cream—which is the same thing—as the particles of alkaline matter left behind by these two materials, commendable as they are in their way. We are satisfied that in one case which came under our notice, soap was the cause of the sleepy cream; and we would also point out the common-sense which is displayed in the old recipe of putting a little sour buttermilk into the churn to "wake it up." A dirty churn, in which some particles of butter have been left to sour, may also cause this abnormal state of the cream; and we have heard of cases in which the milk of a particular cow has been a fruitful cause of trouble. When the misfortune occurs, the sour buttermilk should be tried, or a sudden change of the temperature of the cream, by the addition of a little hot milk; but it will always be found that butter made from sleepy cream is bad in flavour, and

the staler the cream the worse it will be. We have taken considerable trouble to ascertain the opinion of the most practical men upon this question, and the usual answer we have received is that want of cleanliness or bad management is the cause. We are, however, of opinion, and we base it upon a large number of cases which we have personally investigated, that certain unknown properties of the milk are generally the cause. It often happens when the milk is stale, *i.e.* when the cows have been milking for a long time, and we have noticed that it has sometimes occurred when barley straw has been used in the diet. Scalding has been recommended, on the Devonshire plan, as a sure preventive; but we have ourselves witnessed a churning of scalded or clotted cream, which went to sleep just as the ordinary cream had done the previous week, and it could not be brought round. To prevent waste, it was by our advice mixed with skim-milk, heated, and converted into a soft cheese, which, although not of the first quality, prevented considerable loss. Mr. G. Mander Allender has suggested that the primary cause of sleepy cream is want of ventilation in the churn. When the act of churning has commenced, the cream swells, and the surplus air, unable to escape, forces its way into the cream as it does when it is whipped. Martini, the well-known German author, has also devoted some attention to this question. He says: "Sometimes, although churning in the usual manner, a large part of the cream is turned into scum instead of into butter, especially in those dairies where no thermometer is kept, and the cream is put into the churn to cool. By adding warm water or milk to the mass the difficulty is generally overcome; but in some cases, when the proper temperature has been attended to, the cause is a certain extraordinary composition of the cream, particularly a more slimy condition of the casein, which prevents the union of the milk globules. It is sometimes the result of uncleanliness of the milk or cream utensils, and at other times the cow is to blame; it having been observed that, after the use of certain feeding stuffs, the milk of some old cows

is in this way affected. In the latter case, a decoction of the root of *Beinwell* should be added to the cream; while in the former it should be treated with caustic soda and *salzsaure* in succession." Rum and alum have also been recommended. A fresh or dried root of the *Beinwell* (*Symphytum officinale*) is cut into pieces, boiled in water, strained, and the lukewarm decotion well mixed with the cream—the proportion is not mentioned. For the cure of the cow, the following remedy is recommended by Dennenbourg, and has been found to answer well: Two ozs. of antimon. crud. and 3 ozs. of coriander are made with sour milk into 5 pills. One pill is given daily, and, together with 1 pint of vinegar, diluted with 2 pints of water; a handful of salt being also added. Dr. Jul. Lehmann has found that "sleepy" cream is in most instances characterised by a somewhat rancid smell and taste, and by a very high percentage of acidity. What other change of the cream is connected with the "sleepiness" he has not found out; but he has proved, by experiments with sound cream, that butter acids of themselves do not prevent the butter formation. Dr. Lehmann believes that the cause of the trouble is the uncleanliness of the milking implements, especially of the wooden ones; or of the mangers, particularly with broth feeding; or lastly, the method of feeding. The phenomenon takes place oftener with winter than with summer feeding; but oftener still during the transition from the last to the first, and especially when the cows have been fed on large quantities of beet-leaves. Dr. Lehmann accordingly recommends feeders to keep the utensils perfectly clean, by first washing them out with warm water, then scalding them with hot water, drying them in the air, washing them for a few minutes with diluted caustic soda, and lastly washing them with clean water. A four-gallon churn requires half a wine-glassful of diluted caustic soda, of a specific gravity of 1·4. The mangers should be weekly cleaned with lime. It has been ascertained by experiments made on a large scale, on several estates, that caustic soda is a very effective remedy. To pure

caustic soda an equal weight of water should be added, and small quantities of the mixture should be thoroughly amalgamated with the cream, until it turns slightly alkaline, *i.e.* begins to impart a brown colour to curcuma paper. In order to distinguish this reaction plainly, the paper, after having been immersed in the cream, should be washed with cold water. When this degree of alkalising has been reached, the cream should be allowed to stand a quarter of an hour, when diluted acid should be added in drops, until it commences to react; then the cream should be churned, and in less than one hour good butter should come. Care must be taken not to add too much acid, otherwise the formation of the butter will be delayed, and it will become necessary to pour the contents of the churn on a linen cloth, in order to collect the particles of butter. Kohncke, of Mehlbye (Holstein), in 1871, recommended as the result of twenty years' experience, the addition of one wineglassful of rum to 50 lbs. of cream, if the cow is to blame; or one dessert-spoonful of pulverised alum to 50 lbs. of cream, if the utensils are in fault.

Mr. Moss, chemist to the Royal Dublin Society, made some analyses of cream at the Dublin Dairy Show, in October, 1884, when he found that the constituents were as follows :

	From Separator.	By Skimming.
Water ...	67·89 ...	65·55
Fat	24·11 ...	29·04
Solids not fat	8·00 ...	5·41

CHAPTER VIII.

BUTTER AND ITS CONSTITUENTS.

If the question were asked, What article of food, next to bread, is more generally used by every class of society than any other? we have no doubt that the answer would be—Butter! And it is used with reason, for a more delicious flavour than that of a good sample does not exist. Good butter never fails to please the consumer, and he eats it from year's end to year's end with as great a relish as when he first tasted it. At the present time although the manufacture of good butter is steadily yet slowly increasing, there is a great deal of an inferior quality consumed; and worse than this, the various forms of sham butter, such as butterine, margarine, and oleomargarine, are becoming quite established commodities. So far as the health of the public is concerned, we do not think much fear need be entertained, for Sir Lyon Playfair has pointed out that the best samples are prepared from the fat of beasts, which he considers almost equivalent to the fat of the cow. The public are finding this out, and there is no doubt that they readily purchase the best samples of butterine, such as are not only sweet but well-flavoured, in preference to cheap butters, which are either too salt or imperfect in flavour. Butter-makers have therefore a new and formidable opponent against which to contend, and they may rest assured that the only way to realise good prices, and to combat the sham successfully, is to study the manufacture of butter, and place it upon the market in its most perfect form.

Butter, every one ought to know in these days of State education, is the fat of the milk—it is held, as it were, in solution—the globules being so small as scarcely to deserve the name of solids. They are encased in sacs, or envelopes, of casein, which, being fractured by churning, set the butter granules free, when they coalesce and form a solid mass. As a matter of fact, the fats of animals, and many vegetable fats, are composed of the same chemical constituents as the butter we obtain from milk; hence the difficulty in detecting adulteration. In all fats, stearine, oleine, and palmitine form large proportions, with smaller quantities of the glycerides of butyric, capric, and other acids. Dr. Hassall discovered that butter contained more oleine than most animal fats, and this knowledge is valuable in aiding analysis. The three chief constituents melt at different temperatures. Oleine, which is usually liquid, becomes solid only below freezing-point; while stearine and palmitine melt at about 63° Centigrade, differing but slightly. Again, Dr. Hassall, in testing the melting points of other fats, with a view to test adulteration, found that, while butter melts at 33·7 Centigrade, the kidney fats of all our butchers' meats melt at 46·90, caul fats at 45·8, drippings at 46·6, and lard at 43·6. Thus valuable means are afforded for detecting the presence of the above fats in butter. The largest constituent of butter is oleine, a fat of which it may be said, "the softer the fat the more oleine it contains." On the other hand, stearine is equally hard. Of butyrine there is about 6 per cent. in butter, and as this is soluble and not present in other fats, it enables the analyst to approximately determine the value of a sample, and the quantity of foreign fat it contains.

While ordinary butter always contains casein, this ought not to exceed 4 per cent.; indeed, its presence is objectionable, and is the chief cause of butter not keeping. Water, too, is always present in proportions of from 5 to 12 per cent.; indeed, some inferior butters contain more than this, and the buyer, in paying a low price, is deceiving himself, and, perhaps, would not credit

the fact if he were told, that for his pound he only gets thirteen ounces, the balance being salt and water. Thus it would pay him better to give a few pence more and use less, in which case he would consume just as much real butter and gain considerably in the flavour; or if he must have quantity, he could incorporate the water and salt himself, when he would, at all events, know what he was consuming. As a general rule the salt butters at the best shops contain about 5 per cent. of salt, some as much as 5½ per cent., but to these a quantity of fine sugar is often added, and a sprinkle of saltpetre. A very good plan to test butter is to insert a knife in it, the smell of which, when withdrawn, acts as a guide. The only unwholesome form in which neat butter exists is when it is melted. In this state it should be avoided, as it is most indigestible, and it prevents the proper digestion of any other food in the stomach.

"The best butter," said Dr. Voelcker, "is made from poor pasture"—*i.e.* land which does not grow an abundance of grass, but a variety of different herbs, which, while they do not give so much milk, vastly improve the quality of the cream. Food of all kinds affects the quality as well as the quantity of the butter. It is well known that Swede turnips give it a disagreeable flavour, and to obviate this it is recommended that the cows should not be fed with them within an hour of milking. If present in the milk, however, 1 gallon of boiling water may be added to each 6 gallons when in the pans, or dissolved nitre, 2 ozs. to a quart of water, may be mixed with it, in the proportion of 1 tablespoonful to every 3 gallons of milk.

Some persons add a little sour cream to the first fresh cream in the cream-pot; stir it, and let it remain and gather until next churning, the object being to obtain a fuller flavour in the butter. If butter is rancid or imperfect, it may be well washed with new milk, and finished with spring water. This process will dissolve the butyric acid, which is the primary cause of much rancidity. Some dealers also melt it in a

water-bath with fresh burnt animal charcoal, and this is said to improve it.

Among the causes of inferior butter are impurities, or variable temperatures in the dairy; uncleanliness in the milker or dairymaid; irregular or delayed churning; bad churning; carelessly working and leaving buttermilk or water in the butter; careless salting; and bad feeding in the cows. These are all matters which can be obviated or remedied; indeed, they will never occur if the management is conducted, under an intelligent system, by scrupulous and careful people. The dairy of the Munster School, when at Birmingham First Dairy Show, proved conclusively that system is everything, in spite of the sarcasm of many an old farmer's wife; for, in the most severe competition, we remember that it took all the three prizes. Again, the Cork maker, who took the first prize at Melbourne—the butter having been made above six months, and having endured the great changes of temperature entailed by the voyage—worked upon a system. The butter during manufacture was freed from as much buttermilk as possible, carefully salted, and then hermetically sealed. Scrupulous care was enforced, and no handling or overworking permitted. This maker confirms Dr. Voelcker's opinion that "The best-keeping butters are produced on soils which are not over-rich."

The greater part of the artificial butter in the market is manufactured in Holland; and one of the effects of the large importations of this article into Great Britain is that the price of British butter has considerably decreased. Good Dutch artificial butter does not contain any unwholesome ingredients, being chiefly composed of "oleo," another name for oleomargarine, the composition of which is similar to that of butter, except that it is deficient in those aromatic oils which give to the real article its flavour and aroma. Oleomargarine is, in chief, the refined fat which is taken from the body of the steer, while the real article, genuine butter, is the fat which is drawn from the milk of the

cow. The analyst of the American Board of Health and many eminent chemists have analysed and tested oleo, with results showing that it contains as much nutriment as butter. Superior artificial butter tastes much better than an inferior sample of the real article; while it is sometimes difficult to find out by analysis whether it is real or artificial.

ANALYSIS OF BUTTERS AND MARGARINES.

Sample.	Point of Fusion.	Weight of Fatty Acid.	Analyst.
Butter, pure, refined ...	... 94° Fahr. ...	... 88·10	M. Riche.
,, last quality ...	... 96° ,, ...	... 87·75	
Margarine, first quality	... 105° ,, ...	... 95·75	
,, last quality	... 110° ,, ...	... 95·78	
Butter, pure, refined ...	... 96° ,, ...	... 88·00	M. Dalican.
Margarine, pure	104½° ,, ...	... 95·60	
Mixture in two equal parts ...	98° ,, ...	... 91·60	

Since the use of oils of various kinds in the manufacture of artificial butter, the makers have been able to lower the point of fusion sometimes as far as 80° Fahrenheit, so that it has become necessary in testing a particular sample to ascertain the quantity of fatty acids which it contains. In pure butter these reach from 87 to 88 per cent., while those in margarine are nearer 95 per cent. The difficulty in this process is not so great as might be expected, inasmuch as it is necessary to introduce a large quantity of the objectionable fat to make the business sufficiently profitable. It must be remembered, in dealing with imitation butter, that one portion of the fatty acids, caprine and butyrine, are soluble in water and can be removed by washing, whereas oleine, margarine, and stearine, of which common fats are largely constituted, are insoluble in water.

The importations of foreign butter during 1879 amounted to 100,000 tons, one-third of which came from the Netherlands, some 15,000 tons of this Dutch product being artificial. This seems to be a rather high figure; however, considering that there are more than 60 factories in the country, some of which send us

many tons weekly, the amount may no doubt be accepted as fairly correct. The Dutch Government require that all cases containing artificial butter shall be branded as such; but nevertheless, upon arrival in England, large quantities which successfully imitate good samples, are sold as pure butter.

At some farm-dairies in Holland artificial butter is made of 60 per cent. of oleo, 10 per cent. of butter made from sour milk, and 30 per cent. of milk, to which is added a little earth-nut oil, (Arachis oil), which is substituted for olive oil, as it imparts a better flavour.

Many of the establishments used for the manufacture of artificial butter are modified cotton factories, paper mills, linen factories, etc., which, during a period of stagnation of trade, had to be abandoned. The owner of one of these factories, situated at Helmond, imports his oleo from America, and purchases his milk from farmers round about the town. Each farmer takes, twice a day, as much milk to the factory as he likes—the quantities generally averaging from 6 to 10 gallons—at a price of 6½*d.* per gallon, which pays the farmers better than making butter themselves, because North Brabant butter only realises 9*d.* per lb. About 10 per cent. of milk is used in the manufacture of artificial butter at some of the factories, one-half of which remains incorporated with the oleomargarine and butter, so that the finished material contains about 16 per cent. of water. Some manufacturers use olive oil in place of a portion of oleo, and others add water to their milk.

The largest factory in the Netherlands is the one situated at Oss, a village near Hertogenbosch, in North Brabant. It belongs to Messrs. Jurgens, who import from Paris some 50 tons of oleo weekly; they further consume 12 tons of best Kampen butter, and 12,000 gallons of milk per week. Here the oleo is melted at a temperature of about 120° Fahrenheit, and is then mixed with a due proportion of milk and butter. This mass is churned until a butter-like material is formed, which is run off into tanks; it is

then stirred and cooled, passed to the salting tables, worked with an ordinary butter-worker, and made into rolls, after which it is packed and made ready for the market.

The object of using real butter in the manufacture of the artificial article, is to give the latter a grain; but as pure butters, made from sweet cream, would be too delicate in flavour and grain for the purpose of the maker of artificial butter, a suitable product is made in the Kampen district, by churning an unskimmed mixture of sour milk and cream, which gives it sufficient strength of flavour and texture, small quantities going a very long way. This article fetches about £5 per cwt., while good artificial butter may be bought at £3 10*s*. Messrs. Jurgens use a 65-horse power refrigerating machine of the Giffard type to reduce their product to 34° Fahrenheit. Manufacturers generally pay their best workmen 12 shillings per week, besides allowing them to use as much buttermilk as they require. One of the reasons why the wages are so low is, that the inhabitants of North Brabant are Roman Catholics, and will not emigrate to the Protestant provinces, where labour is dearer. This circumstance explains the concentration of these factories in this province, at a distance from the great ports, and the principal milk and butter producing districts, where both wages and milk are dearer. As the quantity of milk sent by the farmers to the factory is too small to allow of its separate carriage, a small dog-cart is used to collect the milk and take it to the factory three times a day, the cows being milked so many times. Holland imports from Paris alone some 250 tons of oleo per month, while the great bulk of its artificial butter is exported to England.

The oleo or oleo-margarine, which enters so largely into the manufacture of artificial butter, is made in Paris, Vienna, New York, and other large cities, from the internal fat of cattle, which is bought by the leading manufacturers by monthly contracts. It must be fresh and healthy, and is first put into large tanks of water, and thoroughly cleansed. It is then ground,

and thoroughly melted in large cauldrons, by means of hot steam-pipes, the mass being constantly stirred by a steel dasher, fitted in the centre of the cauldron. On no account must the temperature be raised above 122° Fahrenheit, otherwise the stearine which it contains will mix with the oleo. It is next run into tanks, on wheels, like store trucks; meanwhile it has assumed the form of a white, warm, pulpy mass, and is taken into another room where the workmen scoop it up and form it into rolls; each roll being wrapped in a white, clean cloth, and laid upon brightly-scoured metal plates or pans. A large number of these pans are then placed in a press, and hydraulic force to the extent of many tons is brought to bear upon them. This causes a yellow oil to exude, which is run off into other tanks of hot water, the cooling of which sends a scum to the surface, which is skimmed off to be sold as tallow. The yellow oil, of the colour and consistency of rich olive oil, is then poured into other large kettles and reheated, that the slightest filaments, or floating particles that remain, may fall to the bottom. It is then left to solidify, when it is packed in casks and stored.

Some very valuable experiments have been made by Mr. Thomas Taylor, Microscopist to the United States Department of Agriculture, in connection with the polariscope, and with different chemicals. While making some microscopic investigations for the Government in 1877, in relation to oleomargarine and butter, he discovered the distinguishing characteristic of the former to be the constant presence of stellated crystals of fat, clearly discernible under a power of 75 diameters, while butter, when viewed under the same conditions, exhibited simply oil globules. Persons writing in defence of oleomargarine, have frequently asserted that these fatty crystals are not present, or could not be detected, and, in proof of this assertion have published photographic illustrations, intended to show that oleomargarine and butter were almost identical in appearance under the microscope. In a few microscopical experiments made with

freshly-manufactured oleo, and also with old or stale samples, Mr. Taylor found the specimens to be very deficient in these fatty crystals, and in one or two instances, could discover none in the field in view; but, recognising the fact that fatty acids are polarising bodies, he applied the test of polarised light, using a selenite plate to enhance the colours. The entire field exposed exhibited a brilliant array of prismatic colours, thus proving, beyond a doubt, the presence of the fatty crystals, although in a homogeneous condition. Pure butter, when subjected to the same conditions, presents but one colour, such as green, red, etc., spread evenly over the whole surface of the field in view, the colour depending in this case on the character of the selenite plate. A particle of lard, scarcely perceptible to the naked eye, if combined with a grain of butter, can thus be easily and at once detected by the use of the microscope in connection with polarised light. In oleo having a lard basis the crystals are larger than those of the oleo having a basis of beef fat, and, therefore, are more readily seen, although both, in their normal condition, are stellated in form. These stellar forms are easily broken up during the process of manipulation, and are frequently seen in the shape of detached needles. In 1881, Mr. Taylor, as the result of some chemical experiments, discovered a very reliable and economical test, which may be easily employed by dealers and housekeepers in the detection of oleo. It consists in combining a small portion of the sample to be tested, with acid, in the proportion of one grain of the substance to two drops of sulphuric acid; the colour which the mixture assumes determining its character. When pure butter is combined with the sulphuric acid in the above proportions, it changes immediately to an opaque whitish-yellow; within 5 minutes a change in colour, beginning at the edge, takes place, and it becomes a very pale shade of scarlet; in 30 minutes the colour deepens perceptibly. Fresh oleo, made from beef fat, when treated with sulphuric acid, becomes at first a transparent amber colour; in the course of about 20 minutes the colour

changes to a deep crimson. When the beef oleo is stale, it quickly turns under the acid treatment to a deep transparent amber, and changes in less than 20 minutes to a dark opaque brown. Fresh oleo with a lard basis, when first treated, changes quickly to a transparent amber—perhaps a shade paler than in the case of the stale beef oleo, and in the course of half-an-hour it assumes a deep brown colour. Fresh oleo, having a vegetable basis, such as pea-nut or cocoa fat, changes in colour to a very pale transparent amber on the application of the acid, and in about 30 minutes it becomes a pale pink tinged with violet. In cases where butter is mixed with a quantity of oleo, the tint will change corresponding to the proportions. As sulphuric acid corrodes most animal and vegetable substances, acting quickly and destructively, it is necessary to use it with care. It should be kept in a small phial with a glass stopper, and when experimenting with it a small solid glass rod should invariably be used, instead of either metallic or wooden implements.

Here it may be stated that an instrument called the margarimeter has been invented, by two Parisian chemists, for detecting the presence of margarine—another name for oleo—in butter. The principle of the invention is the different densities of melted butter and the greasy substances used for adulteration, when raised to a temperature of 212° Fahrenheit. Water is placed in a small vessel, and brought to the boiling point over a spirit lamp. Above is a graduated test-tube, in which a quantity of the butter, previously melted, is placed. The zero point marks the density of pure butter, and each division above this indicates 10 per cent. of adulteration; the tenth division of course indicating pure grease.

Some compounds, which are known as "bosh," contain a large adulteration of water. In making this, butter is melted and stirred with salt and water until it is thoroughly incorporated and cold. In this way more than 33 per cent. of water may be added; the exact quantity, however, can be ascertained by the use of a

graduated tube, in which a certain proportion of butter is melted, for the water will sink to the bottom, when the scale will show the proportion.

There is a manufactory in Bermondsey where butterine is made in the following manner: Beef and veal suet is prepared by cleaning, cutting up, and drying; every shred other than pure fat being removed. Having passed through a crushing machine, it is melted in a wooden tank containing 60 gallons of fresh water, and heated to 608° Centigrade, the following ingredients being successively added, a second not being mixed until the first is dissolved: 25 lbs. salt, 1½ lbs. carbonate of potash, ½ lb. chlorate of potass, and 1¼ lbs. nitrate of soda. The process of melting having been continued for 4 hours, the mass is allowed to settle for a couple of hours, when the fat is pumped into an iron receptacle standing within a wooden one, with water between them, the latter being heated by steam to 358° Centigrade. After the fat is all drawn away, 4 lbs. of salt is added to the matter remaining, to settle all impurities. The fat is next placed in tubs in a hot room, at a temperature of 25° to 30°, where the pressing is facilitated. When the surface is soft and veiny, it is removed by hand, in pieces of about 3 lbs., and covered in cloths to form square cakes, which are placed in rows in a huge press, and subjected to a pressure of 50 tons, when the oleine, to which we have referred, is obtained. This oleine is the material of which the butterine is made, as follows: 20 gallons of new milk are placed in a churn, with 25 lbs. or so of good fresh butter, and churned until the buttery substances are separated from the milk. When this stage is reached, 10 cwt. of oleine, with a quantity of ground-nut, is added, and in the manufacture of prime quality butterine, 4 lbs. of the finest hazel-nut oil, and ½ oz. of "essence of cognac" or hazel-nut are also placed in the churn. If a few ounces of milk-salt and a quantity of glucose are also mixed with these ingredients, it is said to keep longer. The whole is then churned for 2 hours, and coloured if necessary. It is then

removed into marble tanks, cooled by a fan, and passed through rollers, to press out the milk. After all these processes, more fresh butter and salt are mixed as it is found necessary, and a further rolling is given, to completely incorporate the whole of the constituents. The utmost cleanliness prevails throughout. It is stated by one who visited a French factory, that from 100lbs. of suet, 70 lbs. of butter are obtained, and 20 lbs. of stearine, the balance being scraps. The originator of the manufacture of artificial butter from suet was a Parisian named Mège-Mouries. There is no casein in sham butter, hence it is seldom rancid. In a factory in New York oleine is also the foundation of the butterine, but it contains more or less margarine, and a little stearine.

Since the above was written we have inspected the large butterine factory of Mr. Moor, in Hamburg, where the system conducted appeared to be in every way perfect.

CHAPTER IX.

CHEESE, CURD, AND WHEY.

At no period has cheese been so popular in Great Britain as at the present time; and where, if memory serves us well, one cheesemonger's shop was to be found in London twenty years ago, we now find a dozen. The London dealer in cheese has introduced our countrymen to almost every cheese which has any qualification as to tastiness, and which can be brought to England with facility; and thus it is that we are all so well acquainted with the leading makes of the Continent, where so many varieties are manufactured, and where in many parts, they form, in conjunction with bread, the daily food of the workmen. At present there is no comparison between the consumption of butter and of cheese; it is, however, a misfortune that, in consequence of the apathy or ignorance of our farmers, and the peculiarities of the dealers, we are compelled to import so much of both articles. The purchase of foreign cheese is largely on the increase, although there is every probability of a check upon the American trade; and we pay annually a sum of about £4,500,000 for 1,500,000 cwt. It is thus incumbent upon every one who is able, and who values the prosperity of his country, to lift his voice or wield his pen, in order to promote home manufacture and the circulation of additional millions among our own people. Much good can be done by improving our milking cattle, by selecting for milk in breeding by better feeding, by demonstrating to the tenants of the soil the

profitable nature of cheese-making, and by showing those who are already producers how to turn out a better article.

Cheese is a nitrogenous food, and analyses as follows in an ordinary sample:

Water	36¾
Nitrogen	33½
Fatty-matter	24¼
Saline	5½
	100

Dr. Letheby gave the analysis of a good sample of Cheddar as:

Water	36
Nitrogen	28½
Fatty-matter	31
Saline	4½
	100

and of an ordinary skim-milk cheese:

Water	44
Fat	6¼
Nitrogen	44½
Saline	5¼
	100

Dr. Voelcker, however, gave the analysis of Cheddar as:

Water	30⅓
Fat	35½
Casein	28
Sugar	1½
Saline	4⅔
	100

and Cheshire:

Water	32½
Fat	32½
Casein	26
Sugar	4½
Saline	4½
	100

It will be seen that the former of these two leading British cheeses is richer in fat and casein, while the latter has the advantage in sugar, taking as it does a very large quantity out of the milk. This fact, no doubt, accounts for the flavour of the best Cheshire cheeses, the sugar causing the acidity which many of the makers encourage. If we estimate 1025 lbs. of milk as the quantity necessary to make 100 lbs. of cheese, we find that, allowing for the sugar taken out by the cheese, about 36 lbs. are left in the whey—a fact which fully warrants the Cheshire farmers in valuing it so highly for pig feeding—notwithstanding the fact that they first skim it for butter-making.

We have referred to the acidity created in the manufacture of cheese, and it may be remarked that the flavour, as well as the aroma so much appreciated by the cheesemonger, results from the development of lactic acid during the manipulation of the curd. If, however, this development is carried too far, the result is destructive to quality, and a mellowness of both texture and flavour. How it is that the acid accomplishes its results is unknown; but it is a scientific fact that many of the flavours and aromas so agreeable to the human being, are the results of decomposition, or partial decomposition, or of chemical action. That fine cheese is not a mere mass of dried curd is thus apparent, for it is necessary to unite certain constituents, and to develop the lactic acid, which causes the necessary change in those constituents, in order to bring about the best results.

In some parts of the country the pastures yield a much larger quantity of casein than in others, hence the fame which particular counties have acquired for cheese-making. In some districts, too, the summer milk is said to yield 1 lb. of cheese to the gallon, the winter milk making a little less; thus, if cheese is sold at £3 10*s.* a cwt. of 120 lbs., as it was generally in 1882, it will realise 7*d.* a pound, a sum which, taking the whey-butter and whey into consideration, is decidedly superior to the summer price of new milk. With regard to skim-milk cheese, we find that it reaches

10 per cent., or very nearly 1 lb. to the gallon; so that, estimating it as low as 4*d.* a pound, it is superior to selling the milk at ordinary prices—especially as the whey is worth something—unless there are means of realising a better profit in another form. In one of the American factories, where skim-milk cheese is largely made—to take a particular case as a guide—it appears that 1540 lbs. of milk made 50 lbs. of butter and 146 lbs. of cheese. Suppose we make a comparison between the returns of milk and of butter and cheese from a commercial point of view, and take the above as an example. The 1540 lbs. of milk would be equivalent to 150 gallons, which at 8*d.* would be £5. The value of the butter at 1*s.* 6*d.* a pound would be £3 15*s.*, of the cheese £1 15*s.*, and of the whey 5*s.*, making a total of £5 15*s.*, thus showing a decided advantage in favour of the latter process, even allowing for labour, although such a yield of butter could not always be expected. If the milk had been converted into Cheshire cheese yielding 150 lbs. at 7*d.* a pound, it would have returned £4 7*s.* 6*d.*; but when we add the value of the whey, and the few pounds of whey-butter, we do not find it reach the value of the milk, unless it happens that the latter is so plentiful as to make it very low in price. In the best cheese-making districts the cows are reckoned to make 3½ to 4½ cwt. (120 lbs.) of cheese per annum. In one very fine dairy in Cheshire, which we visited when on a Commission to investigate dairy-farming in that county, we found that 100 cows had averaged during four successive years 4 cwt. 20⅓ lbs., 4 cwt. 23¼ lbs., 4 cwt. 8 lbs., and 3 cwt. 2 lbs. 18 oz., in addition to a considerable sale of milk in winter, especially during the last year, the sale of calves and whey-butter, and the value of the whey. In another case we found 80 cows averaging 5 cwt. of cheese; the difference being made up by high feeding. Cheese-making generally ceases in winter, otherwise the yield per cow would be greater.

Again, another experiment, which was conducted in order to compare the profits of cheese-making with those of milk-selling,

may be quoted. 346 gallons of milk were made into cheese and butter, realising £12 15*s.*, or nearly 9*d.* per gallon. Assuming, in the absence of exact figures, that three parts were cheese and one part butter, we find that at market prices these proportions would almost equal the above sum, which proved beyond doubt that in summer cheese paid better than milk. It has been shown that, whereas it takes 9⅓ lbs. of milk to produce 1 lb. of curd in summer, it only takes 7⅓ lbs. in November. Similarly the average quantity yielded in summer is about 10·2, as against 11·6 in November. In comparing the production of cheese with the production of meat, we may assume that the grass which will add 1 cwt. to the weight of an ox will make 430 lbs. of cheese.

We have mentioned that grass, like high feeding, affects the yield of cheese; but, as with butter, the cow herself has a great deal to do with it. In proof of what a cow can do, an instance may be quoted in which a single animal made within a year 76 cheeses, weighing 266 lbs., in addition to supplying butter all the winter, and milk all the year round, to a family of five.

In England cheeses are made in various forms, but the flat circular shape is the most popular. Stilton has a form which is especially its own, otherwise there is not so much difference between our chief makes and those of the Continent. Cheddars and Cheshires are round, flat, and very thick, some of the latter often reaching 80 and 90 lbs., while the general make is little less We may give examples from the many dairies we have visited. Thus, 20 Cheddars measured 1 foot 2 inches in diameter by 10 inches in depth, and averaged 66½ lbs. in weight; others similar in width averaged 78 to 82 lbs. each. Again, 44 Cheshires measuring 15 inches in diameter by 13 inches in depth averaged 90 lbs. Double Gloucesters measure an inch more in diameter, are only 4 to 5 inches thick, and weigh about 25 to 30 lbs. Loaf cheeses weigh 6 to 10 lbs. each in Wilts, and about as much again in Somerset. Stiltons, which lose weight more than any of the hard cheeses, measure about 7 inches in diameter by 8 to 9

inches in depth, and weigh 10 to 14 lbs. America imitates us in her hard cheeses, but there is no resemblance between our makes and the huge, round, flat, dark-coloured Parmesan, the immense Gruyère, the tender Roquefort, or the Edam and Gouda, the round and flat cheeses of Holland. Our soft cheeses are usually brick-shaped and laid upon straws; whereas the Bondon is very small and loaf-shaped; the Camembert round and flat; the Pont l'Evêque, and others made in Normandy, square, diamond-shaped, or made in the form of a flower; while the famous Brie is round, barely half-an-inch thick, and about 12 to 14 inches in diameter. An American maker says that since he began to make his cheeses in the form of a cube, and weighing about 10 lbs. each, in which form they are suitable for slicing as well as for selling whole, he has obtained a penny a pound more for his produce.

Not long since, Sir Lyon Playfair said, in the House of Commons, that he looked forward to the day when cheeses would be made of peas and beans, and having been mixed with good oleomargarine, form nutritious, palatable, and economical food. "Peas and beans," he added, "contain 20 per cent. of cheese, against only 4 per cent. of milk-cheese." But the learned M.P. was quite in error, for, as we have shown, there is nearly 1 lb. to every gallon of milk (10 lb. 4½ oz.); consequently the percentage is nearly 10.

New, or whole milk cheese is chiefly a combination of casein, or curd, fat, and water; whereas, skim-milk cheese is made of the same curd, water, and a small portion of fat, the major portion of which is taken from the milk in the process of skimming. In making cheese, whether it be of whole or skim milk, the solid casein and fat is separated by rennet—a powerful acid described elsewhere—a small quantity of which, being added to the milk at a given temperature, causes it to thicken or coagulate, when the solid curd is removed from the liquid which held it in solution, and which is called whey. This whey contains about 5 per cent.

of sugar and 2 per cent. of fat and casein; hence it is valuable for pig feeding, although in many parts the fat is taken from it and converted into butter. When skim-milk cheese is made, the fat and casein are almost entirely taken from it, leaving but a trace in the whey, although more sugar is left. Whey-cheese is sometimes made, but although it is tolerably nutritious it is not of first-rate quality.

The sugar which is in the whey may be obtained by boiling the latter until all moisture is evaporated. It is seldom used, however, as, although it is valuable, it is only worth three-fourths as much as cane sugar. Whey is usually estimated at 20*s.* per annum per cow; but, if its solid constituents are withdrawn, it will realise considerably more than double this sum. A cow giving 600 gallons, or above 6,000 lbs. of milk per annum, would yield 250 lbs. of sugar and 120 lbs. of whey-cheese. At a low estimate these should be worth much more than the combined value of the whey-butter and the whey given to pigs.

The cheese trade suffers materially from the system of railway charges for carriage. It was pointed out to the selected Committee of the House of Commons that, while American cheese was conveyed from Liverpool to London at 25*s.* to 30*s.* a ton, the rates from Cheshire—nearer to London by 25 to 30 miles—were 42*s.* to 45*s.*; a state of things which is only equalled by the charges for conveyance of French produce on some of the southern lines. Thus it is that our transatlantic rival is induced to use our markets, and it is no wonder that in one year he sent us 1,877,000 boxes, weighing 4,500 tons.

Lastly, it is worth while to consider whether methods of preserving cheese should not be encouraged. Some makes, and especially the Stilton, lose weight rapidly, a cheese weighing 16 lbs. often dropping down to 11 lbs. in two or three months. This, in great part, is caused by mites. Mr. Roumieu has strongly recommended a preserving fluid called "Septon," invented by A. P. Van de Water, of Haarlem, instancing, in support of its

value, a case in which 5 cheeses were taken from one maker, 2 being treated with the "Septon" and the other 3 left in the ordinary way. In 6 months the 2 Stiltons were "in first-class order," whereas the others were not presentable. If this preservative is applied when the cheese is first made, a crust forms in 2 months equal to the matured crust of 7 or 8 months; hence, it not only preserves, but enables the cheese to travel better.

CHAPTER X.

KOUMISS.

DURING the past few years this preparation has become extremely popular, and with reason, because it is at the same time a delicious and a useful beverage. The writer first tasted it in Switzerland, and much as he doubted its value before, these doubts were at once dispelled, for it is a drink which commends itself at once to a refined taste. Koumiss is an effervescing preparation of mare's milk, although it is now made from cow's milk in this country, and is obtained by the ordinary process of fermentation. Its flavour is sweet, and yet slightly acid, and the casein and albumen contained in it are partially digested. It contains a large quantity of carbonic acid, which gives it a sedative value, and it is this, combined with the facility with which it is digested, that has made it such a favourite with the faculty. In a paper upon "Koumiss," by M. Biel, he speaks of it as being like champagne, and other drinks charged with carbonic acid, producing a pricking sensation in the mucous membrane of the nose. Patients—and in Russia it is largely taken by invalids—can live upon it for a length of time, without taking other food. Indeed, taken in large quantities, it removes the desire for solid food; although, when taken in small quantities, it stimulates the appetite. It agrees remarkably well upon the stomach, which it never surcharges or inconveniences, while it excites a most agreeable feeling through the system. When a patient commences its use, it creates drowsiness, which is

irresistible; at the same time it never intoxicates, nor does more than excite a feeling of exhilaration, without any undesirable consequences. It has been made from asses' milk, as well as from the milk of the cow, but the beneficial results to consumptives are believed to be less efficacious from these preparations than from the veritable koumiss made from the milk of the mare, which very much resembles the milk of woman. Treated with rennet, mare's milk does not precipitate the curd, as in cow's milk; but, diluted with a volume of water, and then mixed with acetic acid, the casein is slightly curdled; nor does a current of carbonic acid have any effect upon it, as it has upon ordinary milk. If, however, it is treated with the addition of a neutral salt, it coagulates—but in a far less solid manner than cow's milk. In 1000 parts, the milk of mares of the steppes contains:

Milk-sugar	57·28
Fat	15·62
Casein	13·09
Albumen	2·18
Proteine	4·88
Salts	3·115

The constituents vary, some samples showing less sugar and fat and more casein; and, in koumiss, the time of fermentation, as well as the quality of the milk, has much to do with this. To the above constituents, fermentation adds free and dissolved carbonic acid, alcohol, and lactic acid. In Tartary, koumiss is taken as the waters of the Continent are with us, the quantity drunk averaging about 3 litres a day. It speedily augments the weight of the patient, and in chronic febrile cases this increase is a symptom of better digestion. In cases of advanced consumption it frequently allays the weakening perspirations, disperses the local seat of disorder, and suppresses febrile symptoms.

Mr. Allender, who is an authority upon koumiss, and who, we believe, was the first to prepare it from cow's milk in England, speaks of it in the highest terms. He says it has rare powers of

nutrition in the most acute cases of chronic disease, and it allays vomiting in a remarkable manner. It will be remembered by many that the late President of the United States, when in his most critical condition, drank and retained koumiss. As an ordinary beverage, its consumption is increasing, and with reason; for it is piquant, nutritive, and refreshing, but, like champagne, must be drawn with a tap, unless the bottle is emptied.

At a koumiss factory in Russia, the mares range, with their foals—except when snow is on the ground—in rich meadows. In winter, they are brought into a covered yard, and fed upon barley and straw moistened. A mare with a well-developed udder is milked 6 times daily in summer, but only once in winter; and from 1 to 6 litres of milk are obtained. Strangely, however, when she loses her foal, she almost immediately ceases to give milk.

The manufacture of the koumiss is commenced immediately after each milking. The warm milk is poured into small vessels, into which a small quantity of prepared koumiss has been poured. Each vessel or urn is provided with a stirrer, with a disc fixed on the bottom, and with this it is stirred every few minutes. This agitation prevents it from becoming acid, and at the same time aërates it; indeed, its quality depends much upon the duration of the stirring and the temperature. Immediately fermentation commences the odour is perceived; and in 2 or 3 hours it is ready, if, on testing it in a conical glass, it gives off gas bubbles at the bottom. It is then poured into strong bottles, similar to those used for champagne, and at once corked and wired down.

When it is necessary to commence manufacturing prepared koumiss, a bottle of sour cow's milk is mixed with 10 bottles of mare's milk, and the above method is adopted. After this has fermented for 3 hours, 3 bottles of the new liquid are poured into 10 bottles of mare's milk, and this is then fermented in the same way. The process being repeated 3 or 4 times, with 3 bottles of the prepared liquid and 10 bottles of fresh mare's milk, when,

after several hours' work, the normal fermented liquid is obtained, 1 bottle of which is sufficient for 10 of fresh.

In some parts there are 3 varieties of koumiss recognised: 1, koumiss of 1 day; 2, koumiss of 2 to 3 days; and 3, koumiss of 5 to 7 days; the last being strong and constipating, while the first is weak and laxative.

The following is given by Pigatti as a method of preparing koumiss from cow's milk:

Milk	1000	parts.
Water	500	,,
Yeast	20	,,
Honey	20	,,
Alcohol	30	,,
Wheat flour	15	,,
Millet flour	5	,,

The milk and water are mixed, and the flours are then added and incorporated. The honey and yeast are amalgamated in a mortar, the alcohol being gradually added. The whole constituents are then mixed together in a strong bottle, which must be large enough to leave an empty space within. It is secured with an air-tight stopper and tied down. To aid regular fermentation the temperature is kept at 77° to 86° for 24 hours in summer, and for 48 hours in winter, the whole being agitated 2 or 3 times during that period. It is then strained and poured into strong, air-tight bottles, left 24 hours at 77°, frequently shaken, and then transferred to a cool place. After a few days it divides into 2 layers, which mix readily on being shaken. Thus prepared, it keeps for months.

Dr. Wolf, of Philadelphia, has given some useful hints upon koumiss. He says, that in numerous and varied experiments, some of which were conducted by a Russian who understood its manufacture, he failed to make the right thing; it was generally sour milk with a heavy cream, feeble effervescence, and a repulsive state. During a visit to the fermenting room of a

brewery, he was struck with the icy coldness of the air, and was told that if the temperature were allowed to rise, the fermentation would prove acetous. This gave him a hint, and he used the following formula with admirable results: Grape-sugar ½ oz., dissolved in 4 ozs. of water; dissolve also, in 2 ozs. of milk, 20 grains of Fleischman's compressed yeast, or well-washed and pressed out brewers' yeast. Mix the two in a quart champagne bottle, which is to be filled to within 2 inches of the top, corked and wired, and placed at a low temperature not exceeding 50°, and agitated 3 times a day. At the expiration of 3 or 4 days it is ready for use, and should be drawn with a champagne tap, and not kept longer than 4 or 5 days.

A very interesting work was recently published by Dr. Carrick, physician to the British Embassy at St. Petersburg, in which he shows how his attention was directed to koumiss as a therapeutic remedy. He cites numerous cases which have been under his own notice for years, the patients who 20 years ago were consumptive now being well and hearty. Dr. Carrick visited the Health Exhibition in London, in 1884, and there exhibited a collection of Russian milch mares.

CHAPTER XI

BUTTER-MAKING.

EVERY one connected with the dairy industry is beginning to find out that there is an art in the manufacture of butter, and that there is a difference between samples made according to the old-fashioned plan—if plan it can be called—and those made by men with modern ideas, increased knowledge, and perfected appliances. Butter made anyhow may be fit to eat, it may even be tolerable to the taste, but it will not keep, nor is it always to be depended upon; moreover, the expert can detect it, and it consequently fetches a lower price in the market than it ought to do. We shall attempt to show, in as succinct a manner as possible, how it may be made fit for the table of a prince, how the maximum quantity may be obtained from the milk, how it may be made to keep, and in fact to fetch the highest price in the market. Some persons attribute the quality of the butter, as well as the greatest yield, to the cows, others to the food they eat, and others again to the churn. There is an element of truth in each case, but not the whole truth. The churn cannot obtain more butter than exists in the milk, nor can it make it good if the management is faulty; the breed of the cow has a great deal to do with the quantity she gives, but this is seriously impaired by bad management; and the food, valuable and necessary as it is, is in a great measure wasted if the entire system is not adapted to make the best of it. It is quite true that the Jersey, for instance, is a superior butter cow; and one of the chief causes of this is, that

the globules in Jersey milk are larger than in the milk of the Ayrshire, or the Dutch. Indeed, in the latter they are smaller, as well as less numerous, than in any breed, and it is this that gives the thin and blue appearance to some skim-milk; for in butter-making the larger globules are more readily taken out of the milk than the small ones, and these remaining cause it to retain its whiteness.

Almost every authority and every writer who appreciates the value of our dairy industry, bases his reason for bringing the subject of butter-making before the public upon the fact that, while we are enduring hardships and heavy losses in consequence of the low prices and small yield of farm produce, we are importing millions of hundredweights of butter, all of which might be, and ought to be, produced at home. If it is urged that we also import corn, we answer that grain-farming can scarcely be extended, whereas dairy-farming is in its infancy, and there is not one-twentieth part of the butter made in England that there might be. If the corn-farmer could be brought to see that a dairy-farm would pay him infinitely better, the prospect of decreasing imports might be near. The work of education in this direction must, however, be necessarily slow, and even supposing that by a subversion of the conservative ideas of our farmers the production of butter were at once doubled, we fear that imports would receive but a very slight check, owing to the entire absence of any system of bringing British butter into the market. It is the duty of every advocate of an extension of dairying on English farms to point out this fact. The farmer should be shown that it is as much to his interest to assist in the establishment of mediums of sale, as to make a first-class article. In other words, until we have a system under which dealers are enabled to purchase farm butter *en gros*, and place it on our chief markets, British producers of the best article will not obtain ready sale at remunerative prices.

It has been the custom among makers for generations past, even in the best dairies, to make butter from sour cream, chiefly

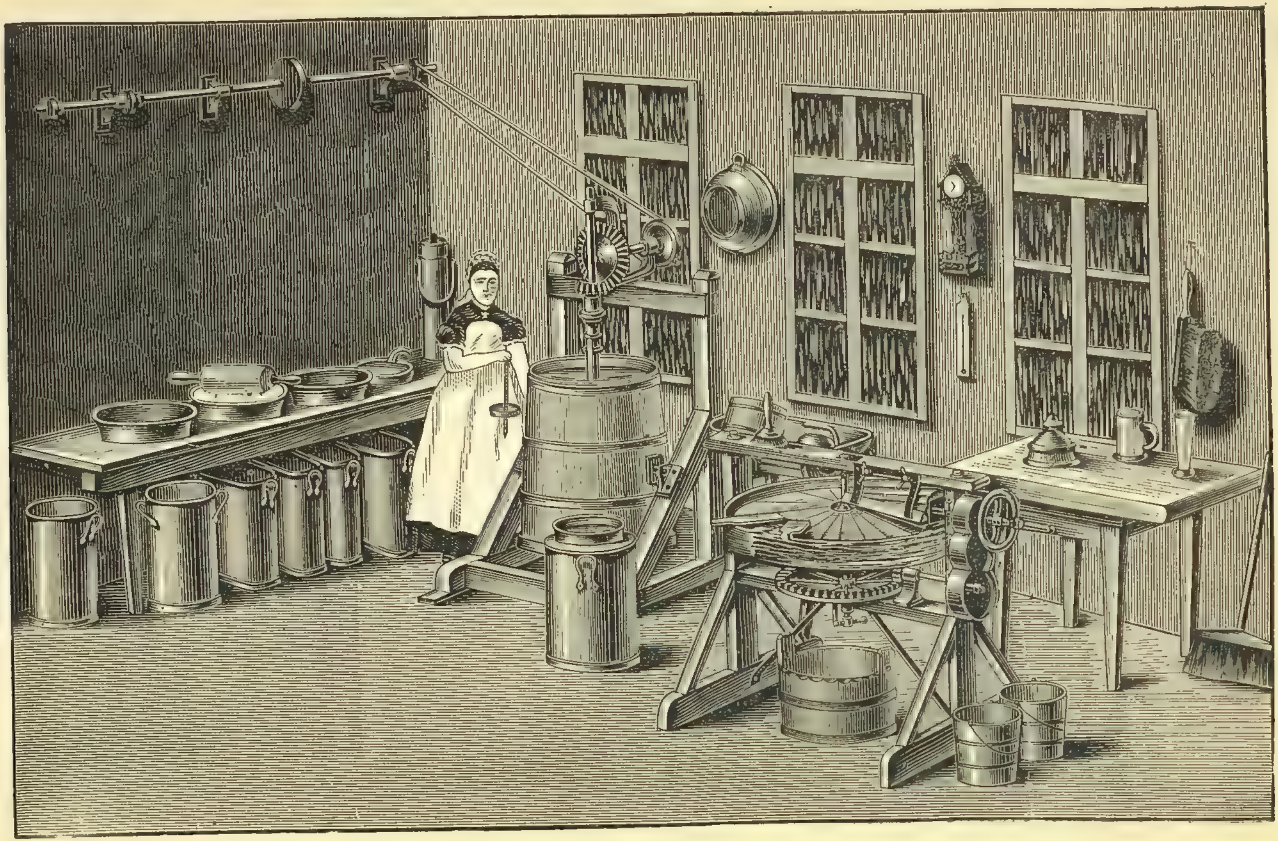

Fig. 14. A Butter Dairy in North Germany.

because the yield was 3 or 4 per cent. more. It was our custom, we candidly admit, and although we had no cause to complain of the quality of our butter, yet we are now persuaded of its superiority when made from cream which is skimmed from sweet milk and afterwards slightly ripened. The flavour is finer, and much less curd is left in it. It may be remarked that although the system is possible during the greater part of the year, yet it cannot be carried out in the hot summer months, when the cream, like the milk, sours so rapidly. It is true that with the shallow-setting system, in a dairy where the temperature is 65° to 70°, souring cannot be prevented, unless ice is used, and this cannot often be obtained, if, indeed, it can be obtained at all. The only plan, therefore, in such a case, is to set the milk vats or pans in cold spring water, and, except upon the hottest days, this will answer very well. There is, however, a system which needs no qualification; we allude to the deep-setting system, which is described elsewhere. This will enable anyone adopting it to keep both milk and cream for a much longer period, so that the cream can be churned in greater bulk, and before it has over-ripened.

The following remarks upon this subject, by Prof. Arnold, one of the most prominent American writers upon dairying, are interesting, and, indeed, valuable, although the conclusions he arrives at are not such as our ablest authorities would endorse. He says:

"It is quite doubtful whether as much or as good butter would be obtained from cream raised by the Cooley process, and churned sweet, as there would be if it was churned a little sour. The finest quality and the greatest yield depend more upon giving the cream a certain degree of ripeness, by exposure to the air at a moderate temperature, than upon the single fact of its being sweet or sour. When it can be kept sweet till the proper ripeness is secured the best results are reached, but if this cannot be done, it is better to let it sour than to churn it when the cream is too immature. In the Cooley process, the milk being submerged, the cream gets

but little airing, and the temperature is too low to allow of much change in the short time required to get the cream all up and ready to skim. Milk which has been submerged at 40°, and is then raised to 60°—a temperature favourable for ripening—will seldom acquire a suitable maturity for churning in the short time it will remain sweet, as it will sour very soon, and it is better to let it do so than to churn while sweet but too new. The Cooley process, therefore, is not a favourable one for making sweet cream butter, and it would hardly be advisable for the average butter-maker to undertake it. To make sweet cream butter successfully, the milk should be set in open vessels and pretty well spread in pure air at about 60°. If the milk is sound, as it should be, the cream will then be so well exposed to the air as to be ripened sufficiently for churning perfectly in 36 to 48 hours and still be sweet, and will give butter of finest quality and as much of it as though it had been kept till it was sour. This course, it is plain, will require more room and more labour than deep and cold setting, and also more skill and attention. Which is the better plan may depend on circumstances. Sweet cream butter is generally in disrepute in the market, not because it is not possible to make it equal to sour cream butter, but because it is churned while too new—before it has become ripened. A distinction should always be made between sweet cream old and new—between butter from cream ripened and from cream not ripened."

There is another little matter which seriously affects the butter, and that is the manner in which the milker finishes each cow. With some the operation of stripping is tedious; but if each cow is not stripped of her last drop at each milking, the loss of butter in the year is enormous in a large dairy, for the last milk is the richest.

The whole of the butter-making utensils being ready and scrupulously clean, the cream may be stirred in the pan and well incorporated, and then poured into the churn, care having been taken to see that its temperature is about 57° or 58°. Every

dairy should be provided with a thermometer, as, if the cream is not at the right temperature, good butter cannot be made, and it is in great danger of being spoiled. If the dairy is about 55° the cream will be all right, and some persons do not object to its being as cold as this, or even as high as 61°; but on no account should it be higher or lower than 60°, unless in winter, when a couple of degrees above 61° will do no harm. If it is too low, some persons stand it in a warm kitchen until it has reached the required temperature; but warm water of about 80° may be added if it is not lower than 55°, as it damages the cream to suddenly raise it more than 4° or 5°; or the cream-jar may be stood in a vessel of hot water. It is a better plan to add warm water than warm milk, as is the custom in some districts, because the milk leaves behind a quantity of curds, which are worked into the butter, and increase its weight. In summer the cream may be too high in temperature during the day; therefore the best plan is to churn very early in the morning when it is coolest; and although this will not be necessary under the deep-setting system, yet it will seldom be found too high under the old system if taken at this early hour. Should there, however, be any apprehension on the point, the cream-pan should be placed in a vessel of the coldest spring water overnight. The system of adding very cold water or ice we do not approve of, for some portions of the cream are subjected to excessive cold, whereas others are not affected at all, or in a very slight degree. Some of the box-churns are constructed to enable the worker to place hot or cold water in an outside case, and this changes the temperature of the cream while it is being churned. It need scarcely be pointed out that this plan is injudicious, for, upon the face of it, the temperature cannot be ascertained, and, with hot water, the cream cools as rapidly as it warms. In the action of churning, a medium machine should be turned about 45 times in a minute, and during the first 10 or 15 minutes the churn should be ventilated by hand, if it is not provided with a self-acting ventilator. An

accomplished butter-maker can tell by opening the churn, and subjecting his hand to the temperature, whether there is any probability of butter coming or not, and there is no better test of the value of the thermometer than this. In one of the churning competitions at a great exhibition, the man working a first-rate churn could not get the butter to come. He appealed to one of the experienced men attached to a dairy company, who, testing the temperature of the churn with his hand, found that it was much too high. Having rectified it, the butter came readily enough. Churning should be very regular, without sudden jerks, as though the machine were a toy. Those churns, of whatever form, which act upon the whole of the cream at once, and whether they rotate or oscillate, are much easier to work, and they produce the butter equally as soon as other churns. Professor Arnold says that a churn should not operate by friction, but by concussion, as with small dashers or paddles, only a small portion of the cream is touched at each rotation.

Another thing to be remembered is that a churn must never be filled too full; a small quantity of cream may be churned in a large churn, but a small churn must never be overloaded; indeed, it should never be more than half filled, or bad results will follow. During the whole period of working, the same pace should be observed; but it may be mentioned that large churns may be turned slower, and small ones quicker, than the number of revolutions we have named above.

Butter takes different periods of time in coming, at different seasons of the year. Sweet cream often comes in half the time that sour cream takes, and the latter usually comes in 40 minutes; whereas clotted cream comes in 10 minutes, often less. In churns which have a little window of glass, it can be seen when the butter is coming; but in other churns the sound must be the guide, and when the separation of the butter is heard a few more turns will cause it to gather.

If churning is stopped in time, the butter will be in the form

of small grains, and the buttermilk should then be run out through a strainer or small sieve, the butter carried through being returned to the churn. This having been done, the proper quantity of salt may be put in; if too much it will not matter, as it can be readily washed out again, for salt has a much greater affinity for water than for butter, and will leave the latter for it at any time. Next add some clean spring water, at about 58°, enough to float the butter, shut the lid and turn the handle gently a few times. Then run the water out through the sieve, and repeat the cold water process. Some persons advocate repeated washings, but we believe this may be carried too far, and the flavour of the butter injured. At all events it is the best way to salt it, and by a little judicious management, and with practice, it will be easily salted to taste. Good salt and plenty of cold spring water are absolute necessaries in the manufacture of butter.

If it is suspected that the butter is not all extracted, and that some remains in the buttermilk, it can be ascertained by the following plan: Put a quantity of buttermilk into a long bottle or a test-tube, add ether to the depth of an inch above the buttermilk; shake well for a few minutes, and then set the tube away for the ether to separate. Next pour off the clear ether, care being taken that no milk goes with it, set it in an open glass vessel in a warm spot, when it will evaporate, and leave behind any butter which it may have dissolved and taken up. If it leaves none, there is no waste; if some butter is left, the percentage can be ascertained by weighing.

There are cases now and then where the cream of one cow turns into butter more quickly than that of another, when there is waste; but this seldom occurs. Again, it sometimes happens that the butter will not come, and if the cows are old, or poorly fed, this may occur. Some persons add a little sour buttermilk, others hot water, and others dash a bunch of keys or something similar into the churn to break it up and admit the air. So long

as it does not go to sleep, however, it is sure to come if persevered with. Sleepy cream is dealt with in a previous chapter.

The butter being gathered together within the churn, it should be taken out with a pair of long-handled patters, with finely-fluted faces, such as are used by buttermen. These are called Scotch hands, and with them the butter need never be touched by the naked hand. A wooden board or a marble or slate slab will do very well for working the butter upon, but there is nothing like the new hand machines, which are now generally in use, for by their aid the buttermilk is well worked out, and drains away immediately. Even the cold hand, which is the pride of some dairymaids, cannot compare with this machine. It must, however, be remembered that butter may be worked too much, as well as too little, and the grain destroyed. In the hot months, when it is soft and sticky, the coldest part of the day should be chosen, and plenty of spring water used, if ice cannot be procured, or it will not be worked satisfactorily.

We never recommend the colouring of butter; but, as it is a process which some persons insist upon—no doubt because the public demand it—a few words will be necessary. The butter of Jersey and Guernsey cattle is always rich in colour, sometimes objectionably so, although it varies, and is paler in the winter. We have, however, noticed that in awarding prizes; the best judges invariably select *medium* colours, while the highest colours—even among the Channel Islands samples—are unnoticed. In colouring, it is essential to use annatto (*Bixa orellana*)—which is *not* mixed with water—a liquid which is cheaper than the more modern article, and which is mixed with fat. This prevents any uneven or streaky appearance, and should be added to the cream in the cream-pot and stirred before churning. A colour may be prepared from pulped or scraped carrots, which answers very well. The roots, when ready, are pressed, and the liquid from them is strained and kept for use.

There is a popular belief that white butter is not so good as

that which is a rich yellow, but this is not a fact. On grass, a cow gives butter of the highest colour peculiar to her; on hay and roots, it becomes much lighter. In France, as well as England, a rich colour is sought, but we are all eclipsed by Spain, for her people insist on a deep orange tint, which is too bright to be agreeable to us. There is no doubt that colouring is a superfluous habit; in addition to being useless, it interferes with the flavour, and it takes both time and money away. Makers are not all so good as to use the best annatto, while some who make their own, mix it with melted butter and pour it on during the process of making—a most objectionable plan. In some parts of the Continent a dye is prepared, which is made from the bark of the berbery root; but, although a drop will colour a half-pint of water, it takes very much more of the extract than of good liquid annatto, such as Fulwood's, to produce the same effective colour in the butter. If we were required to use a large quantity of colouring matter regularly, we should prepare it from carrots; if not, we should prefer to purchase annatto from a respectable maker.

We now come to the question of salting the butter. In some parts fresh butter is eaten without having been salted at all; in others it is well salted. When salting is necessary, there is no better plan than to roll the butter out on the slab or board of the worker, and sprinkle it evenly with from half-an-ounce to an ounce of the finest butter-salt. It may then be worked in with the roller, and thoroughly incorporated. While unsalted butter will not keep many days, it will, if salted, keep for a long period, and may be sent to distant markets. The salt should not be too fine, or it will dissolve and pass away with the buttermilk and water. If not very pure, its foreign constituents will affect the butter which it is intended to preserve. When the proper proportion has been ascertained—and this is important where butter is marketed—the maker should rigidly adhere to the quantity, which should be allowed by weight, for no other system will he find so accurate.

The system of salting advocated by Dr. Klenze and others is as follows: When the greater part of the buttermilk has been extracted, the butter is weighed, and laid out in flat cakes of about 2 lbs. each. The salt is strewn on one cake, and a second placed upon it, which is also salted, and the same plan is adopted with all. The pile is then cut down into four, and the whole kneaded with the butter-worker. It is then made into a single lump, left for some hours, and then worked again until no more water can be extracted, when it is ready for packing. The butter will not adhere to the utensils if they are scalded with hot water, and then rinsed in cold just before using. In Denmark, when the butter-worker is not used, the butter is placed in a clean wooden trough and lumps of 2 lbs. or so are pressed by the hand against the sides a few times to squeeze out the buttermilk. It is then weighed, the salt measured, and the pieces flattened; they are next salted, and laid upon each other as before. Slices of about 3 lbs. each are then cut down, and worked in the trough, and formed and re-formed several times until all are worked, when they are united and left in a cool place for the salt to dissolve in the buttermilk which remains; but it must not be left long in the cold weather or it will become too stiff to work properly. It is then pressed with a worker a few times. In summer, when the butter is very soft, it is not worked until it has become more solid; and this is managed by placing thin slices, of about 2 lbs., in tin boxes lined with pieces of wood, to prevent it touching the metal. The box is placed in the coldest water until the butter is firm enough. Though the last working is done with a machine the others are by hand, which is a bad plan at all times, when compared with the work performed by the butter-worker. When the operation is completed, the butter is placed in layers in tubs for market. In packing butter in firkins or tubs the latter should be washed out with salt water, and a layer of salt strewn at the bottom as well as the top.

In most counties there are systems of preserving butter, which are excellent in their way, and which have their special adherents. In some parts we have seen the butter packed in large open earthenware crocks, in which it keeps very well, but which had a much more powerful flavour of salt than of butter. Small jars are very useful for the purpose, such, for instance, as will hold from 2 to 4 lbs., or even more. When properly salted, the butter can be placed in these to within an inch of the top, and covered with a layer of salt laid upon a thin piece of muslin. Another way is to fill the jars with granulated butter, taken from the churn and rinsed in brine. When nearly full, the jars may be filled or nearly filled with strong brine, a piece of muslin covering the top and having a layer of salt above it. The salt will not only keep the brine from losing its strength but it will prevent the butter rising in the brine. Care should be taken to fill the jars while the granules are hard and firm, and they will then remain so. This plan causes the butter to retain its delicate aroma, and it will keep for an almost indefinite time. If, for instance, a sealed jar is opened after several months, and the brine rinsed off the butter, it will be found quite equal to a newly-churned sample; so that there need be no apprehension of over-salting, for to over-salt the butter must have the salt worked into it. If, however, on taking the granules from the churn the whole are formed into a mass and worked, the brine adhering to it will give it a salting of about 3 per cent. It may here be convenient to describe the process under which granulated butter is obtained. The granules are believed to be as perfect as is the arrangement of the atoms of an eggshell; hence, in churning, the object should be to prevent them being broken and to obtain all at once. When the butter has come, and before it has gathered, it will be noticed that it floats upon the buttermilk more like thick cream than butter. Cold brine should then be poured into the churn, a little at a time, so as to reduce the temperature to 54°, the handle being gently turned all the time. It will then form into granules, and may be taken from the churn.

In America, when butter is preserved in tubs, oak being generally used, they are soaked in brine to draw out the woody flavour; they are then filled with boiling brine and left to cool. When ready for packing, an inch of salt is laid on the bottom, and this is covered with a false head, in which a number of holes are bored; on this a piece of muslin is laid, and both heads are fastened to the sides by wedges. The butter is covered with brine all the while it is being filled, and, when full, the lid is nailed on, and brine poured in, through a hole which is bored in it, until it rises over the cask, when a plug is inserted and the tub turned bottom upwards.

Again, a good plan for preserving in vessels which are not air-tight, is to fill little muslin bags, which have had the starch washed out, with granulated butter, and lay them in the keg or vessel, covering each with salt and a little brine, to prevent the air reaching them. The top bags should be first covered with the brine, and then the vessel filled up with a layer of salt. Butter, in any form, may be well kept by this system.

Something may now be said about the "Omnium" preservative, which is the patent of the Aylesbury Dairy Company. Butter treated with it has been sent to all parts of the world, and has been eaten 8 months after packing in as perfect a state as when it came from the churn. In using, the butter is laid out on the slab in pats of 2 inches in thickness. It is then indented, the Omnium poured over it, and the indentations closed over. It is next salted to the extent of 1½ per cent., and rolled up, that none of the liquid may escape; after this it is worked, so that the preservative may be thoroughly intermixed, or the consequences may be serious. One great advantage is, that butter so treated need not be packed in air-tight vessels. The quantity of Omnium used should always be measured, and the full allowance need not be added if the butter is to be kept less than 2 months; that is, ½ an oz., instead of 1 oz., to every 14 lbs. of butter is sufficient; but, in this case, it should have its own bulk of water added to it,

or it will not properly intermix. The amount of salt necessary when using the preservative is 1 oz. to every 4 lbs. of butter, and this is merely to give it the palatable flavour which is generally esteemed. The constituents of the Omnium are not exactly known, but they are stated to be actually present in natural butter, although of course in very small quantities.

When all the arrangements of butter-making are completed, the utensils should be cleansed. The best plan is to have a large kettle ready on the fire, so that you can at once pour the boiling water into the churn, then shut the lid, ventilate and churn for a few minutes, and finish by running out the water and turning the mouth of the churn downwards to drain, the tap being left open for ventilation. The remaining utensils should be first rinsed in cold water, and afterwards scalded and stood to dry.

When butter is to be despatched in small cases, there should be a layer of clean white paper round the sides and at the bottom, over which clean muslin, which has been scalded in water or Glacialine solution, and then cooled, is laid. Rolls may be separately wrapped in pieces of muslin, and the whole should be packed so that it will not shift its position in travelling. Fancy-shaped pounds and half-pounds are fashionable with new beginners and suburban residents, but the public prefer plain rolls; and if a visit is paid to any large exhibition, where there may be a hundred or more samples, it will generally be found that the best makers prefer this shape. Making up should never be conducted directly the butter is worked, but 8 or 10 hours afterwards, when it has drained and become more solid.

In England, butter is sent to market in small quantities only, and until there is some medium by which the produce of each farmer can be taken in bulk, the trade is not likely to escape from its present small dimensions. Mr. Jenkins has recommended the factory system, or an association of farmers, which alone would be able to obtain a footing in the London market.

Churning Milk.—In these days few persons who know anything

about dairy work, churn new milk in preference to cream, although in some parts of Lancashire and one or two other counties it is still the custom, as it is in some of the more remote parts of France and Germany. There are certain advantages in the system, it is true, but they are more than counterbalanced by the disadvantages. The former may be summed up in a few words: There is no necessity for a dairy in which to set the milk for the rising of the cream; the butter is obtained in a fresher and perhaps sweeter state, although with much less flavour and aroma; the buttermilk which is obtained is much superior to that resulting from the churning of cream, and in many respects has the properties of sweet milk, just in fact as is the case with the skim-milk obtained by means of the cream-separator. It must not be forgotten, however, that in churning milk it is requisite in almost every dairy to churn daily; indeed, where a large number of cows are kept it would be compulsory either to churn more than once, or to use a motive power of considerable force in order to deal with a necessarily large quantity of milk. This is one important argument in favour of churning cream, but it is not nearly so important to the dairyman as the fact that in churning milk he leaves a very considerable percentage of the fat in the buttermilk; this he practically loses, for the buttermilk would be just as saleable if the whole of the fat had been extracted from it. As the churning of milk, then, is on the one hand excessively troublesome, on account of the continuous churning, and a most expensive luxury to the farmer on the other, it is to be hoped that those who still adopt the system may be induced to give it up altogether. In churning sweet milk it is generally the custom to churn at a temperature of from 64° to 68° Fahrenheit. Mr. Jenkins has pointed out to us a fact which we had not remarked, that new milk is churned in the North chiefly because there is a large demand for buttermilk.

M. Pouriau describes a system of manufacturing butter without churning at all. He says that the farmer pours the cream into a

cloth neither too thin nor too thick; the corners are gathered together and fastened securely, so that nothing can come into direct contact with the cream. The whole is then buried in the earth at a depth of 7 to 12 inches, and taken out at the end of twelve hours, when the cream will be found quite firm. It is then worked, a little water having been poured upon it, and the buttermilk immediately separates from the butter. The operation is stated to furnish butter of very good quality.

CHAPTER XII.

CHEESE-MAKING.

It is hardly necessary for a practical man to refer to the gigantic imports of cheese into this country, or to the fact that those imports have increased in a remarkable way, to ascertain how necessary it is that something should be done to encourage cheese manufacture. He knows very well that on the one hand the public need instructing in cheese-making, and showing how they can make it at a profit, while, on the other hand, he is well aware that it cannot be made to perfection, nor to compete with the produce of other nations, unless the best appliances are used—such as not only add to its quality, but to the cheapness of its production. The general public, however, know little of the state of the case, therefore, we show them, by the aid of a few figures, what we actually import, and how immensely the imports have increased:

In 1861 we imported to the value of	£1,636,799
In 1880 this had risen to	5,091,514

or more than treble the value.

In 1861 the quantity imported was	706,395 cwts.
In 1880 this was increased to	1,775,997 ,,

Thus, while the quantity is getting larger and larger, the price is becoming higher, and the quantity made at home smaller. If demand is any guide, surely cheese-making must be a lucrative

business, when energetically conducted, and when made upon scientific principles, and with the most perfect appliances. To meet foreign competition, British makers must look to quality, and there are men in the country who have made the subject a study, who have invented apparatus well adapted to make the very best possible cheese, and who will readily give their advice. On the one hand, there exists the fact that some makers rob their milk of part of its cream, and then exercise considerable skill in the manufacture to make up for the deficiency; while on the other hand there are makers who, while giving the cheese the benefit of all the cream, manufacture upon old-fashioned principles, and fail to produce an article of the highest type. The difference in value between whole-milk cheese, and cheese made from milk from which some cream has been taken, is from 12*s.* to 18*s.* per cwt. The perfection of coagulation, and the adoption of a right temperature, is another cause of success and failure. Again, while there is one common opinion about the breaking up of the curd, the action is performed by different people in different ways, and with different implements, from a skewer to a many-bladed knife. Next, the treatment of the curd after it has been completely separated from the whey varies greatly in certain districts, in some of which makers prefer to heat it before the whole of the liquid has been extracted. In the manipulation of the curd, mills and grinders of various patterns are employed, and nowadays no first-class maker is without them. The principles are much the same in all cases, but the prices vary, as well as the quality of the material of which they are made. There is also a great variety of cheese-presses—machines which, once acquired, are of immense value to the maker, saving a great deal of trouble, and acting with greater precision. While there are several makers of all these implements, who turn them out in a most elaborate manner, we regret not to find a single instance in which a manufacturer has offered for sale utensils for the manufacture of soft or fancy cheeses. It may, perhaps, be remarked that none are necessary;

but we have made butter without a single utensil, as well as hard and soft cheeses, hence the same argument can be applied to butter appliances. Are there no firms who will offer cheap sets of utensils for the purpose, and who will undertake to give practical lessons in the manufacture? The ingenuity of man is so great, that, if he anticipates a large sale, he will quickly design and make a little set of utensils, such as could be used with advantage in the direction we point out. There is no doubt that the advice of an expert maker of cheese appliances is valuable when fitting up a place for cheese-making. More particularly is this the case with regard to the cheese-room. It has been pointed out that cheese is not made until it is marketed; and there is no doubt that, however perfectly it is made, the cheese-room affects it materially for better or worse. If ill ventilated and badly warmed, there is a direct money loss; but it is of no use to shelve cheese for a long time in a damp room, and then heat it unduly for the last few weeks it remains. The great point is to keep to one temperature, and then, with good ventilation, no fault can be found. Much can therefore be done by using the shelves, stands, and presses which we describe. Colouring, too, is a subject upon which many makers differ, those from one district often taking a leaf from the book of those in another, and *vice versâ*, each class being dissatisfied with its own method. If we were about to start cheese-making upon a large scale, we should certainly take the first opportunity of visiting some of the best cheese fairs, and, selecting the best makers from among the exhibitors, endeavour to see their modes of manufacture, and apply them, as far as was possible, to our own case. The dairy-farming public are not sufficiently acquainted with the methods adopted in other districts, any more than they are with the best machinery in use.

Although the manufacture of cheese in this country is neither so extensive nor so perfect as we could wish to see it, and, notwithstanding the fact that it occupies a position which is by no means distinguished when it is compared with other countries, yet there

are potent signs of a change being imminent. At no period has so much interest been displayed in all that appertains to cheese-making, nor has there ever been so many practical expressions of the general desire to raise the industry to a position consistent with the importance of its results or the greatness of the country. Cheese-making in England is not a new industry, but, from a variety of causes, it is not so popular as it should be; and while the educated taste has been led by the cheesemongers to patronise the products of France, Italy, and Switzerland, the humbler consumer is provided for by the makers of Holland and America, where, it cannot be denied, much more is done in the way of cheese-making than with us. In 1880 America exported 40,000,000 lbs., of which we took 65 per cent., while her home trade is growing at the rate of 12,000,000 lbs. a year. We wish the same could be said of England. The factory system, which is largely adopted in the States, has much to do with this; and it has been shown—we believe by Mr. Oliver—that, whereas it would cost £250 to build a dairy for 50 cows, a factory for 500 could be erected for £1000.

In England the principal cheeses are Stilton, Cheshire, Cheddar, double and single Gloster, Derby, and Leicester. These are the highest in esteem, and the most largely consumed. In making all these varieties, there are various systems which are peculiar to the districts in which they are made; but, as in butter-making machinery has done wonders, so in cheese-making it has been of the most material assistance. English appliances are both numerous and good, and cheese manufacture is not equal to them; at the same time it must be admitted that we have learned much from other countries, more particularly America. The immense and increasing imports of cheese are not so much due to inferiority in British cheeses, which are too few, as to the fact that our people do not bestir themselves and compete with the foreigner. In the first place, we have not a sufficient number of cows—hence the demand for milk by our large towns induces very many

producers to sell it; whereas, if the supply were larger, many would be compelled to look to cheese-making instead. There are, however, very many persons who would make cheese if they knew how; they need instruction, they want to know something about the appliances used in the manufacture, as well as descriptions of the various systems themselves. We hope to supply this information, and our description of the most perfect known machinery and utensils will, we hope, be read with interest. During the past few years considerable improvements have been made, foremost among these being the introduction of the American square vat, in place of the old tubs once so generally used. While we admit that these have a decided advantage in one way, we think that the round ones have it in another, more especially the very beautifully-made copper vats used on the Continent. The first square vats were used at the Royal Agricultural Show, at Bristol, in 1878, where they took away the prize from the old-fashioned ones. Since that time they have gradually gained ground, and become most popular among the largest makers.

"The finest flavoured cheese," said Dr. Voelcker, "is CHESHIRE." It differs from many other makes in being made from milk which is perfectly sweet, and it is believed by some authorities that its true aroma is due to this fact; although others again state that it is not possible to produce a finely-flavoured cheese from sweet milk, as from milk which has been slightly soured. The following method of manufacture is one that prevails in many well-managed dairies in Cheshire, in which Cluett's well-known apparatus is in use:

The evening's milk, when taken from the cows, is passed through a fine sieve into the milk vat, underneath and around which is a hollow cavity or chamber, and which, to cool the milk and drive off the "animal odour," is filled with cold water. If the weather is close and hot, it is sometimes necessary to turn off this water and add a fresh supply, in order to bring the milk

down to the desired temperature of 72°. Next morning the morning's milk is added to the evening's, and hot water or steam is turned underneath and around the milk, until the thermometer shows about 90° of heat. A certain quantity of rennet is now added to the milk, to produce coagulation, and if it is desired to make a coloured cheese, the proper proportion of annatto is added at the same time. When these have been thoroughly mixed with the milk, the vat is covered up for about 50 or 55 minutes, at the end of which time coagulation will be perfect. The dairymaid now proceeds with the operation known as "breaking down." This is effected with one of Cluett's curd-cutters, which is made of steel blades, tin-coated, and is constructed entirely without wood. This operation of breaking down, or cutting the young curd, is a very delicate and important one, and upon the care and skill and patience of the dairymaid at this stage of the process, depends, in a great measure, the richness or quality of the cheese. If the operation is roughly or hastily performed, the whey, or liquid, separating from the curd, will be white or milky, and so the cheese will be impoverished or robbed of butter, just as much as if a certain quantity of cream had been extracted from the milk. On the contrary, if the operation is carefully and patiently performed, the whey, or liquid, will be green and clear, while the perfect combination of butter and casein will make a cheese of first-class quality, rich, and full of meat. When the young curd is cut up sufficiently fine, it is allowed to settle to the bottom, and immediately afterwards is quietly and carefully gathered or collected to the upper end of the apparatus. The whey is then drawn off by means of the tap at the lower end of the apparatus, and conducted to slate cisterns by a length of hose attached to the tap. A rack, or drainer (consisting of eight laths about an inch apart), is then placed in the vat at the lower end, and upon this a very coarse cloth. The curd is then cut into small squares and placed upon the cloth, to facilitate the draining of the whey from the curd. When this separation of

the whey and curd has been partially effected, the curd is placed in a tin pan, where it is gently broken by hand, and salted in the proportion of 8 ozs. of salt to 20 lbs. of curd. It is then replaced upon the cloth in the drainer, and, after being frequently cut and turned, is passed through the curd-mill, and placed in a wooden circular vat to give the cheese the shape desired. After vatting it is generally kept in a warm temperature, usually in a small chamber or oven, as it is called, behind the fireplace, for one or two days, when it is taken to the press-house (which should be kept warm and free from draughts), and after being pressed and daily turned in a dry cloth for five or six days, it is removed to the cheese-room, turned over twice or thrice a week, until, in a few months, it is ripe, and fit for the market.

During our visit to Cheshire to thoroughly master the system of Cheshire dairying and cheese-making, we went over nearly thirty first-class large and small dairies, including the Aldford factory, and whether the old or new system was adopted, we found everywhere the greatest cleanliness and care, and the same method of making; although some makers take off more cream than others, and one or two make at a higher temperature. The farm at which we saw the system most completely carried out was that of Mr. Siddorn, The Oxheys, near Tarporley, and our description of his process—which combined his own theory with his wife's practice—in the *Manchester Guardian* newspaper, was fully borne out by the fact that, at the Cheshire Dairy Show a few months later, he took the champion prize. Among other first-rate makers may be mentioned Mr. Byrd (inventor of the Cheshire pail), Mr. John Lea (who makes at a temperature of 80°, raising to 84°), and the three brothers Fearnall; indeed, we might continue the list, for, in every case, we found the most creditable of systems and samples.

In some districts the milk is heated as high as 80° before the rennet is added, when it is gradually raised to 100°. The squares of curd, too, are cut larger by some makers than by others, and

having been removed and drained, it is broken up by hand before salting. By the adoption of a correct system—and the heating process has very much to do with this—there is a development of acidity, which gives the cheese its fine flavour. Some makers consider it very important to ripen their cheeses quickly, and get them into the market; but this can only be done when the cheese-room is a good one, and the daily management of the cheeses really thoughtful. Competition is now so strong that nothing but the very best make can hold its own in the market, being run very closely by the American and Canadian samples. Lord Tollemache has done much to give encouragement to Cheshire cheese-making, and it is to be hoped that his example will be more generally followed.

CHEDDAR cheese-making, like the Cheshire, is a leading branch of dairy husbandry in this country, and although makers are beginning to use appliances of modern type, yet there are many who still adhere to the old-fashioned tub. The Somerset farmer still prefers to turn out his daily cheeses from April to November, and to hope for the better prices which in the cheese trade are so often in the future. Cheddar cheeses are not made of any special size, but vary from say, 60 to 100 lbs. each—according to the size of the dairy. If a number of cheeses from particular dairies are examined at the factors, they will be found to be somewhere near the following examples: 20 cheeses weighing from 70 lbs. to 92 lbs., and averaging 80½ lbs. per cheese; again, 68 cheeses weighing from 72 to 81 lbs. per cheese, and averaging 76 lbs. They run a little more than a foot across, and vary in depth to 14 inches. The ordinary sized Cheshires are very similar in shape, but do not run quite so heavy; there are, however, lump Cheshires which are much smaller. In an ordinary dairy of, say 35 cows and 150 acres, the cheeses run from 60 to 100 lbs. each; and a special instance may be quoted, in which the farmer never exceeded 100 lbs., nor made a cheese of less than 65 lbs. In making Cheddar cheeses the evening's milk is added to the

morning's and heated up to 80° or thereabouts, when the rennet is added. There is a distinct prejudice in Somerset against acids of a chemical nature, and nothing but the real thing is used. When the curd is well set, and it takes about 50 minutes, it is very carefully cut, that the cubes or squares may remain whole and not mix with the whey. This being done, the whole mass is further heated to 98°, which has a decided effect in solidifying the curd, and separating it from the whey, which is at once run off. In some dairies this whey is set for cream, and in one instance we know that several pounds of butter are made weekly from it. This is a complete answer to those who state with such authority that whey contains no fat. The whey drained off, and the curd reduced in temperature by the process of turning, piling, and cutting, it is passed through the mill, and then gathered into a cheese cloth and pressed in a frame. Next, it is broken up, salted—2 lbs. of salt per cwt. being used—and again passed through the mill, and finally put into a clean cloth and pressed until the following morning, when the cloth is changed and a bandage placed round it. It remains in the press two more days before it goes into the cheese-room, where it should ripen in something less than three months, if the temperature is right and regular. Some makers complain of the prices they get from the factors or middlemen, and there is no doubt that, as in other businesses, they sometimes have cause, especially if they have not the energy to look elsewhere, instead of leaving themselves contentedly in the factor's hands.

Derbyshire has long been a cheese-making county; but it was shown very conclusively by Mr. Colman, before the Committee of the House of Commons, why the industry is not in the position it ought to be. The Hon. E. W. Coke, who has done a great deal to assist Derby cheese-making, was also examined before the Committee, and gave some most important information. He said:

"In Derbyshire it is usually considered that a cow needs 3

acres of grass ; but the rule does not apply in the case of a large farm. For instance, a farmer holding 300 acres, would not have 100 cows, whereas a farmer occupying 60 acres may very often keep 20 cows. The reason for this difference is, that in going beyond a certain number of cows on a farm, the milking becomes a difficulty. The strength of a dairy farm is dependent upon the number of hands that can be found to milk, these hands being, during the intervening hours when milking is not going on, profitably employed otherwise on the farm." Mr. Coke says that in his immediate neighbourhood the milk is almost entirely made into cheese, which is manufactured at the cheese factory in his parish. The factory was started under the management of Americans, and during the first year they made cheese on the American system, pure and simple; but it was soon found that this was useless, and that if they could not do better than make American cheese, the undertaking had better be abandoned. Accordingly, during the second year, the factory proprietors adopted the Cheddar system of cheese-making, with the same kind of implements as those used on the other side of the Atlantic. The guarantee of 6½*d.* per gallon to the tenant farmers continued for the years 1870 and 1871, after which the factory passed entirely into the hands of the farmers. The following tabular statement, compiled from a paper handed in by Mr. Coke, shows the average selling price of 120 lbs., and the amount per gallon of 10 lbs. realised by the farmer for his milk, for the nine years ending 1880 :

Year.	Per cwt. Cheese.		Per. gal. Milk.
	s.	*d.*	*d.*
1872	74	9	6¾
1873	82	4	7½
1874	82	4	7½
1875	74	1	6½
1876	71	6	6¼
1877	79	9	7¼
1878	64	0	5½
1879	66	6	5½
1880	78	0	7
Average	74	9	6¾

Mr. Coke is of opinion that this average is nearly 10*s.* per cwt. higher than the average home-made cheese, and the managers of the factory consider that they can make the cheese at about half the cost at which it can be produced in private dairies. Taking the general results of the factory movement at Longford, Mr. Coke considers that it has been beneficial to his property, inasmuch as the contributors have obtained a much better price for their cheese, and it has been made at less cost. From a landlord's point of view, too, the movement has been a great success, as the improved well-being of his tenants is a great element of success to the landlord himself.

In making DERBY CHEESE, the two milkings are added together and heated to 84°, before the addition of the rennet. Having been well mixed by stirring, the whole is allowed to stand one hour before any manipulation commences. When quite set, the curd is broken up, with the aid of a specially made utensil, into small pieces the size of a pea, when it is allowed to settle slightly before it is piled up in the centre of the vat; the whey being let off by a tap at the side. Where Bamford's apparatus is used, a tin plate, perforated with small holes, and fitting the vat nicely, is now placed on the curd, and the whey drains off by a lower tap. When lifted again, the curd is carefully cut and once more piled up in the middle; it is afterwards lowered again, and this time pressure is applied to it by the aid of a screw in the apparatus. When this has been repeated several times, until, in fact, the curd is tolerably dry, it is removed into, and twice passed through, the mill; after which it is salted in the proportion of ½ lb. to 56 lbs. of curd. It is then gathered up into cloths, about 40 lbs. in each, and placed in the press, where it remains an hour, when it is taken out and scalded for one minute in water which has been heated to about 150°. Next it is returned to the press for five minutes, then given a dry cloth, and again pressed for some hours, when it is removed and salted well all over. It is again salted on the second and third days, after

which it leaves the press, is washed in warm water, bandaged, and placed in the cheese-room for 3 weeks, when it goes to a cooler room until it is sold.

In some Derbyshire dairies a sieve-like curd-breaker is used, the wires across it cutting the curd into ½-inch squares, although it is questionable whether the whey can be kept so green as it should be, to prevent the cheese being robbed of its quality, as if they were a little larger. Some, too, cover the curd, in the centre of the vat where it is gathered, with canvas—of course, after it has been broken up, drained and settled again—and place the edges under the bottom of the curd. This acts very effectually as a strainer preparatory to the application of the follower, or close-fitting perforated board. Derby cheese-makers are most particular in their management—the temperature, the breaking of the curd, the pressing, use of clean cloths, salting and drying,—these all being matters to which they attach the utmost importance. Derby cheese-making is not confined to the county of Derby and district, for the system is largely patronised at the Duke of Westminster's factory, although it is not found so profitable as the Cheshire system.

Gloucester Cheeses need no further reference than the remark, that the system under which they are made resembles the Derby system so closely, that the latter may be taken as an example.

Leicester Cheeses are very popular, and we know more than one connoisseur who prefers a really good ripe sample of this make to any other, and there is some reason in this choice. Such cheeses as Mr. Samuel Pilgrim places before his guests at his annual Shorthorn sales, are worthy of the criticism of any one, and knowing of no better maker, we give a description of the method he adopts in manufacture. Mr. Pilgrim is of opinion, that the quality of the land has much to do with the flavour of the cheese, and instanced to us a case in which a well-known prize-taker owes much to this. In Leicester cheese-making, the

rennet is made from wet or dry skins, according to the fancy of the maker, these being cut up and boiled in a quantity of green whey, which is carefully skimmed, and then cooled to a tepid temperature, a small quantity of salt and saltpetre being added. If well made from thoroughly good skins, it is used in the proportion of about 1 pint to 80 gallons of milk. When the milk is put together for coagulation, the thermometer should show a temperature of 76° to 78° in summer, but during the early and late months of the year, it should reach 80° to 84°. As a general rule the curd is not fit for breaking up under 90 minutes, the coagulation being slow, and the process carefully managed in order that the curd may not be bruised or lose quality. After the curd has settled down, and it takes about 20 minutes to do this, the whey is drawn from the tap of the vat, or ladled out according to the apparatus in use. The curd is next gathered into a cloth, well-pressed and broken up a number of times until it is sufficiently free from whey. During the last working a small quantity of salt is added. It is next placed in the hoops, in dry cloths, and put into the press, where it remains 24 hours. It is then well salted on the outside, and this process is repeated daily for 4 or 5 days. Lastly, it is well washed in warm whey or greasy water, and placed on the shelf to dry, but is not sufficiently ripe for table for 12 to 15 weeks. Mr. Pilgrim is of opinion, that the plan of colouring with annatto—which is added when the cheese is put together—is a mistake, for it neither improves flavour nor quality. Upon the average, it takes about 11 lbs. of milk to make a ripe Leicester cheese, therefore, it may be assumed that a gallon will make a tolerably new cheese. The most important points to observe in making this, as other cheeses, are, that the milk is at the proper temperature when put together, that the moisture is thoroughly extracted, and the cheese sufficiently cured. All these, however, may be accomplished, without the result of producing a really fine-flavoured

cheese, for this depends upon the pasture more than anything else. There are many farms in the Leicester district, which are noted for producing fine cheeses; but it is the opinion of good judges that there are more second-class dairies made now than twenty years ago; high-class cheeses being rare exceptions. This cannot result from bad management, or want of skill in the manufacture, so much as from the improvement which has taken place in the land by manuring and draining. By this process the nature of the grasses has been changed, and it is tolerably well known among cheese-makers that cold, wet, marshy land generally produces the finest cheese, for there are cases in which this very land, when drained and improved, fails to produce the old quality, although it doubtless produces more. It is, however, doubtful whether this quality compensates for the difference in price between the present and former times. In Leicestershire much attention is paid to acidity, and, to help this, a proportion—about 2 lbs. for a 40-lb. cheese—of old, sour skimmed whey is put into the milk, when the rennet is added. It also assists in preventing the cheese from lifting, or swelling, when it is ripening during hot weather. The formula for making rennet is:

3 gallons of old sour whey boiled,
¼ lb. saltpetre,
2 lbs. common salt.

When cooled down to a tepid state, put in six skins well cut up, and stir the whole. The Patent Extract of Rennet is now, however, much used and approved.

Lancashire is not famous for its cheeses in the same way that the sister county of Cheshire is famous, but a considerable quantity of a very good cheese is made there; and, as it can fairly take its place as an English make, it is entitled to a description of its system. There are three systems of salting: One, in which the cheese is brined whole; another, in which it is hand-salted; and a third, in which the salt is mixed with the curd; in other respects the systems are the same. The

evening's milk is placed in earthenware pans, which, in summer, stand in tubs filled with cold water. In the morning the dishes of milk are skimmed, and all the cream is in some cases churned into butter; in other cases, only part of it. Some makers mix the cream with warm milk the following morning, and a cheese thus made is said to have "all in"; while that from which part or the whole of the night's cream has been taken, is described as having been "robbed." By the mixing of rennet, the milk is made to curdle in about 1 hour and 45 minutes. The curd is broken with a "breaker," made of galvanised wire—a utensil resembling an oval cinder-riddle with a handle. After breaking the curd, the maker gently stirs it with the hand (commencing at the bottom), for about 20 minutes, and then removes the whey. Next, he breaks up the curd by the hand into lumps of some 5 inches square, and places them in a coarse, open cloth, which is tied up by the corners into a bundle and then placed upon a bridge; a board is laid over it, and pressure applied by a lever. If it is desired to make a large cheese, the curd, while in the cloth, is placed in a basket of open willow-work. It is removed from under the weight in half-an-hour, when it is cut up into pieces of the size of an egg, and replaced under weight. This is repeated 4 times, at intervals of 25 minutes, after which 2 table-spoonfuls of salt are added to 30 lbs. of curd. It is then passed once or twice through the curd-mill, and ground as fine as grains of wheat, when it is placed in the cheese-vat, covered with the "follower," and allowed to stand without any weight upon it for about half-an-hour. Then the lever weight is applied, increasing the pressure gradually for about 3 hours, when it is covered with a fine cloth, replaced in the vat, and pressed for 22 hours; during which time it is once turned and put into a fresh cloth. It is next stripped of its cloth and put into a brine, which is made as follows: The water is boiled, and "rock"-salt added, until a raw potato will swim in it, when it is allowed to cool. A 30-lb. cheese requires 4 "brine

mugs"; these are made of earthenware, and are circular in shape. In some dairies the brine is put in long wooden tubs, in which the cheeses are left from 4 to 7 days, according to size, being turned daily. If the brine is strong, the cheese rises above the surface some 1½ inches; if it is weak, the surface of the cheese will be level with that of the brine. Where "brine-mugs" are used, the cheese is passed on from one to the other for 4, up to 7 days, according to size. When the cheese is put in the first of the series of mugs, a layer of salt is placed upon the top of it, and when it is removed, this salt is thrown off into the brine to restore it to its original strength. On taking the cheese out of the brine, it is wiped dry and clean, and placed in a cool place for a few days, when it is greased with bacon fat and removed to the cheese-room.

Some makers mix a portion of curd kept over from the previous day; others use only new curds. The old curd is kept overnight in a dish in a cool place, and is ground cold in the mill. In warm weather, the cold old curd is mixed with the warm "new curd"; and in cold weather the old curd, after being ground, is warmed before the fire, being stirred the while, so as to get it equally heated throughout. For colouring, some use liquid annatto, and others the cake. As regards the rennet, or "steep," this is made in several different ways. North of the Ribble, two vells or skins, or "bag skins," are put to every 2½ quarts of water, some salt being added; the latter ingredient, however, is often dispensed with. The quantity of rennet used for curdling varies from two table-spoonfuls to half a teacupful. As thermometers are seldom used in Lancashire, we are unable to give the temperature at any of the stages of the process of making; but we know that in the best dairies the curds are kept comparatively cool.

The principal difference in the modes of making "brined" cheese and "hand-salted" cheese consists in the salting, the maker being anxious to use as little salt as possible for the latter kind, in order to fit it for toasting. The curds are kept cool, and

the whey is removed more carefully and slowly. A very small teacupful of salt is added to a curd mass of 35 lbs. at the time of grinding; this mass being afterwards placed in the cheese-vat and left for 2 hours, without any weight upon it, for fear of impoverishing the curd. At the expiration of the 2 hours a very slight weight is applied, which is gradually increased from hour to hour. About eight o'clock p.m. the cheese goes to press, and is lifted out next morning at the same hour, when it is well rubbed all over with fine salt by the hand, and then replaced in the press until night. After this second removal it is placed upon a stone shelf, with a layer of fine salt under and over it. Next day it is turned, and after 3 days the salt will have been absorbed, and the crust become dry. In about a week's time it is taken to a cheese-room of somewhat lower temperature than those used for brined cheese. Hand-salting is principally practised in the district south of the Ribble, and dairy-farmers there make their rennet daily—a piece of skin, 4 by 2 inches, being left in a basin of cold water for 24 hours.

The third method is that of salting the curd, called the "new" system. Some makers mix the salt before grinding the curd in the mill, and others after, the proportion of salt used being 1 to 85. The great difficulty is to bind the cheeses in such a manner as to keep them in shape. Some makers envelop them in a piece of calico made all in one; others put loose pieces over and under when placing them in the press. These pieces are made to overlap the edges, and on taking the cheese out of the press, binders are put round close to the top and bottom. In some dairies, when the cheese comes out of the press, calico covers are affixed, with flour paste, to the top and bottom surfaces, and then binders applied. With the exception of the small number of makers who allow plenty of time, and regulate the temperature, the greater part of the producers supply a cheese called "springy," or soft, which never becomes properly solid; the crust is too thin, and the outer rims only kept in their places

by the binders. For some five miles around Lancaster there is hardly any curd-salted cheese made. The Fells district cheese is the softest, yet it keeps the longest. Concerning the Fylde district, it may be said that, notwithstanding that there are a considerable number of inferior dairies, the art of cheese-making has made great progress of late years.

WENSLEYDALE CHEESE is made in and about the Vale of Wensley, in the North Riding of Yorkshire, where the pastures are especially rich and profuse. The cattle are acclimatised Shorthorns, and the feeding simple—grass and hay being almost the only food they get. Mr. Livesey, who wrote an able article in the *Dairy Farmers' Journal*, says that in one village (Hawes), in the Dale, as much as 7000 lbs. of butter has been sold on a single market-day. The system is more like the Swiss than any we know. No corn or roots are given. The cows are milked in the fields, and the milk is carried home in "Budgets."

Wensleydale cheese is made either in the "old" or in the "new" way, and the following is a description of the former.

The evening's milk is heated, and then the morning's milk added, when the mixture should be about 100° Fahrenheit. The rennet is then mixed in the proportion of 1 pint to 5 cows' yield, and the boiler covered with a wooden lid. The temperature of the room is about 40° Fahrenheit; and it is important to keep up the temperature of the curd at 100° Fahrenheit, otherwise, instead of feeling "sharp," it will turn pasty, and stick in the curd-mill. Some 35 minutes after the addition of the rennet, the curd will be fit to be broken up, which process occupies about half-an-hour. The broken curd is left to stand for three-quarters of an hour, by which time it cools down to 90° Fahrenheit, the whey being then removed. At 82° Fahrenheit the mass is put into cheese-vats lined with dry cloths, when a light pressure is applied, and after half-an-hour it will be at 65° Fahrenheit. It is then cut up small, replaced in the vat with a dry cloth, and left to drain for an hour, when this treatment is repeated, and

another hour allowed for draining. The curd will then be 55° Fahrenheit, and at this point it is ground in the mill; after which it is placed in vats, and pressed for 24 hours. A calico bandage is then stretched round it, and it is put into brine for 3 days, when it is taken out and simply wiped dry with a cloth. 100 lbs. of milk usually produce 12 lbs. of cheese under this system. In another instance we found it stated that in summer it required from 10 lbs. 4 ozs. to 10 lbs. 1 oz., in September 9 lbs. 8 ozs., and in October 8 lbs. 10 ozs. of milk, to make 1 lb. of cheese.

The new method is a simple and short one, but we doubt whether it would answer for cheeses of large size. Wensleydales generally vary from 10 to 15 lbs., except in the small dairies, where they make cheeses of 4 and 5 lbs., and are flat shaped, if we except one variety, in which the shape is an imitation of "very deep" Stiltons. Most dairies consist of some 8 cows; only a few counting 15 to 20; but even the latter make the day's milk into more than one cheese. Wensleydalers curdle their milk in the "cheese-kettle," and not in a large tub, as is done in Lancashire. This kettle is made of copper or brass, large in size, and in appearance similar to the pans used in Lancashire for heating the whey. The evening's milk, after being heated, is taken off the fire, and the morning's milk added to it. The rennet, or "prezzur," as it is called, is made daily, or every other day, by cutting a few pieces of calf's stomach and placing them in cold water for 24 hours. When the milk has acquired the desired temperature, the rennet is mixed with it, and after three-quarters of an hour, the curd will be fit to be broken up into very small pieces. This is generally done by the hand; others use a breaker made of wire, crossed as in a riddle, circular in shape, and very small. Instead of having a handle, a part of the outer wire rim is drawn out and bent. In breaking by the hand, the movement is upwards, but by the breaker it is downwards. The whey is removed (by ladling it off), and the curd placed in a circular tin,

11 × 4 inches, with perforated sides and bottom. These tins are left to drain for 3 hours, when they are reversed, and left for another 3 hours; then the curd is removed to the vat and pressed for 24 hours; after which it is kept in brine for three days. The temperature has, meanwhile, been regulated as follows: Before curdling, 96° Fahrenheit; after adding hot whey, 95° Fahrenheit; when vatting, 66° Fahrenheit. In summer the temperature is kept lower than in autumn. The brine is made on the Lancashire plan, namely, by boiling the salt in water; and to be good, it should allow an egg to float in it. Some dry salt is placed on the top of the cheese as it floats in the brine, and this, melting, restores to the brine the strength which the cheese absorbs. For colouring, the cake annatto is used. As the climate in this district is of a low temperature, with much rain, and as the rooms are not heated, the cheese is kept cooler than in any other part of the kingdom. The cheese is kept in the cool-room for 7 days, when it is removed upstairs to ripen. At the season when the fogs set in, instead of being kept in the cool-room for a week, the cheeses are placed upon shelves suspended from the kitchen ceiling.

The Wensleydale cannot compete in appearance with the Lancashire. It is small, kept too cool, and has a greyish coat. The makers should not continue the manufacture so late in the year, and should keep the rooms warmer, either by hot air or steam pipes or stoves, by which modification they would be enabled to turn out a cheese which would not only command a better price, but also regain the formerly high character of this particular make.

STILTON CHEESE needs no description or recommendation. It is, without doubt, the best British make, and it is questionable whether it will not bear favourable comparison with any European variety. The real thing is, however, not so easy to obtain as may be supposed, and the reason is, that the make is limited—first, because the grand pastures which suit it cannot well be extended; and, second, because the system employed is still kept very close.

Numerous instances could be given in which first-class shopkeepers have been unable to supply their customers with anything better than an imitation, which has neither the flavour, the aroma, nor the consistence of the choice article. Stilton first appeared upon the tables of the Bell, at Stilton, about 100 years ago, and quickly gained a reputation, which it has ever since maintained. It is now made between May and September, during which time the cows are in the pastures, in which alone they feed, for the addition of artificial food perceptibly interferes with its quality. The rennet used was, strangely enough, said to be made from the stomachs of lambs, instead of calves, and in the process of manufacture the curd is not ground. "These cheeses," says an old writer, "are sometimes called the Parmesan of England, and are not considered to be sufficiently mellow until they are two years old, nor ripe until they exhibit spots of blue in the interior." An old receipt gives the following formula for making: To 8 gallons of new milk add 1 gallon of cream, and set at the temperature at which the milk comes from the cow, after mixing with 2 tablespoonfuls of rennet. Cover it, and allow it to stand 3 hours. When coagulated, take the curds into a sieve-strainer, and continue to agitate until the whey has well drained off. Next place one-half the curd into the vat, salt with a handful of salt, and cover with the remaining curd. Place it in the press, which should be provided with a small weight, and turn at night. The next day the cloths must be twice removed, and so for the two following days, when it will be fit for the shelf.

The following is the system adopted by Mr. Thomas Nuttall, who is justly celebrated as a maker of prime Stilton, and whose method is decidedly an improvement upon that to which we have above referred: The milk is emptied into a large strainer, from which it passes into the cheese-tub, 14 feet long by 4 feet wide, made of wood lined with tin, and capable of holding 600 gallons. By means of steam or cold water the temperature of the milk is brought to 79° Fahrenheit, space having been left

between the wood and the tin to admit either. Then the rennet, made from green cured skins (1 oz. to 10 gallons of water), is added, and thoroughly mixed with the milk, which curdles in about 1 hour and 30 minutes. Next, four persons remove the mass of curd with shallow tin bowls into cloths, which are placed in tin drainers, 6 × 2 × ½ ft. Iron bars are fastened across these at intervals of 1½ feet, to hold the sides of the cloths. Two of these drainers are placed in a frame 2 feet apart, one above the other, when the full frame is removed, to make room for an empty one, the whole tub being emptied in about 25 minutes. The cleansing of the tub and utensils is done chiefly with steam, obtained from a boiler which works a 5-horse power steam engine, used to pump the water from a well to a reservoir on the top of the building, and to heat the rooms, grind the curd, etc. The cloths containing the curd are loosely tied by the four corners, allowing the whey to separate partially for one hour, when the taps of the drainers are turned, and the whey is drained off altogether. Then the cloths are tightened, and placed close together in a large drainer of about the same size as the cheese-tub, in which they remain 12 hours. The cloths are again tightened, and the curd is placed in other coolers. After a while the cloths are removed, the curd is cut up, and in 18 hours it is coarsely ground. The morning's and evening's curd are thoroughly mixed with one another, and with fine salt in a proportion of 1 to 60. The mass is then put into tin hoops with perforated sides, 12 inches deep by 8 inches in diameter; and the filled hoops are arranged on shelves in a brick-floored room of 65° Fahrenheit. In 6 days the whey will have run off and the cheeses are then removed from the

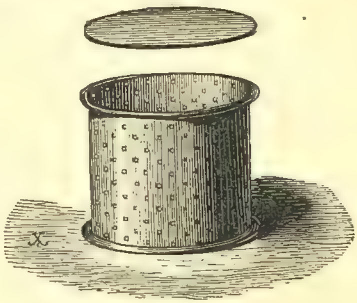

Fig. 15. Stilton Cheese Mould.

hoops and taken to the binding-room. Here they are shaped with a knife, and strong calico bandages pinned round them daily for 12 days, when they get firm, and are removed to drying-rooms of 65° Fahrenheit. The cooling is effected by means of water trickling from a perforated pipe, and the heating by steam-pipes. Ten lbs. of curd placed in the hoops produce 5 lbs. of cheese. Stilton cheese is made twice a day from new sweet milk, fresh from the cow, but without the addition of extra cream, as some people seem to think. If one thing requires greater care than another, it is the constant and precise regulation of the temperature, and the avoidance of waste during the various stages of the manufacture. Mr. Nuttall was awarded both the Gold and Silver Medals of the British Dairy Farmers' Association, at the Islington Dairy Show of 1877. The Americans have commenced to manufacture Stilton cheese, and the late Mr. Willard was the first to describe the points in the above system which are most suitable to factory work in his country.

SKIMMED MILK CHEESE.—The following is a system of making cheese, which is practised in America. It is described by an eye-witness, who says: "The cheese-vat contained milk that had been set for 24, 36, and 48 hours, and the cream taken off as closely as it could be gathered. The proportions were 535 lbs. at 24 hours, 425 lbs. at 36 hours, and 547 lbs. at 48 hours, making 1,507 lbs. in all. This included the buttermilk, which amounted to about 300 lbs. The skimmed milk was heated to 82°, when the buttermilk was poured in and mixed well with it, and the whole allowed to stand until the entire mass was properly acid, as it is considered that thoroughly sour milk makes better cheese under this process than sweet milk. It was then heated to 86°, and the extract, which is the peculiar feature of the process, was added in the ratio of 1 oz. to 100 lbs. of milk. This extract is composed of an alkali, which changes the milk from sour to sweet, and an antiseptic, which acts as a preserver.

For 10 minutes the milk was continually stirred, in order to have the extract thoroughly distributed through it. Then the requisite amount of Hansen's Extract of Rennet was added, and in 11 minutes the milk began to thicken, and in 25 minutes it was cut. The heat was then increased to 88°, the batch being intended for a southern market, although ordinarily it would be scalded at 94° or 95° according to the weather. As soon as the curd was well separated from the whey, the latter was drawn off, leaving the curd perfectly sweet. The object, then, was to get it to press as soon as sufficiently cool, and the temperature was reduced to 70° by pouring on cold water. The curd was next salted—3 lbs. to the 100—the salt being rapidly and evenly mixed in, and then it went to press. It is considered of more importance to put the curd to press while still sweet, than to have it thoroughly drained, as the whey will be squeezed out in the press. The peculiarity of this process is its contrast with the old method. Instead of working a sweet milk up to an acid standard, it reduces sour milk to a perfectly sweet curd. The alkali used to effect this result is potash, a substance which is taken out of milk with the cream, and which is as essential to its full value as any other constituent. Of course, there is always more or less fat which is not taken out of the milk by skimming, and it is claimed that the alkali "saponifies" this fat, so that it will not become rancid upon exposure to the atmosphere.

It remains to give the result of the batch of milk of which we have been speaking. From this 1,507 lbs. of milk there was made 50 lbs. of butter and 146 lbs. of cheese. The average would be 1 lb. of butter to $25\frac{1}{2}$ lbs. of milk, and 1 lb. of cheese to $10\frac{3}{10}$ lbs. of milk. This was in the latter part of October.

Another process is one which has been adopted by Mr. Ellsworth, of Massachusetts, whose aim is to manufacture cheese *and* butter. The milk to be made into cheese is heated to 135°, cooled down to 60°, and set for the cream, which is skimmed at 36 hours. This, in fact, resembles the Devonshire plan. The

cream is churned sweet, and he adds skimmed milk to the churning. The sweet buttermilk and the churned milk are then mixed with the skimmed milk, and made into cheese by the Cheddar process, the whey being drawn off before much acid has developed. It is believed that if the milk is heated, the casein is softened and rendered more manageable, curing as easily as whole milk curd. The heated milk, too, gives a finer flavoured buttermilk than milk which is not heated, and materially assists in the curing process. The maker also believes that the churned milk promotes the curing. This cheese is said to be first-rate and may be easily mistaken for whole-milk cheese. We commend this process to British makers, believing that there is very much common-sense in the process, and that it is one of the very best systems of utilising skimmed milk.

Buttermilk Cheese may be made by hanging the buttermilk over a slow fire, in order that it may curdle. The whey must then be strained off, and the curd salted and worked. It should next be tied tightly in a coarse cheese-cloth and hung to the ceiling for a few weeks, when it will be fit for eating. The addition of a little butter to the curd will improve it materially, especially if it be kept for three months.

A system of making Potato Cheese is to add one portion of curdled milk to two portions of potatoes (which must have been boiled in their jackets until mealy), cooled, skinned, and beaten to a pulp. Having been salted, the mixture must be well worked with the hand, and allowed to stand for three days, when it should be again worked and drained. Having become tolerably dry, it should be potted, like butter, and not eaten under a fortnight.

English soft Cheeses are made in a variety of ways, although the principal form is that of a brick, the curd being laid upon straws. We give the following systems, all of which are good.

Add a pint of new milk to a quart of fresh sweet cream, a little sugar, and the necessary quantity of rennet—the mixture being

about 75° when the rennet is added. It should be placed near the fire until coagulation is complete, which may be ascertained by dipping in the finger, to which, if ready, no curd will adhere. A vat, the shape of a brick, should be provided, together with two mats made of straight wheat straws sewn together at both ends. The curd is placed in the vat, one of the mats being at the bottom, and the other at the top. It is allowed to stand until the next day, when it is turned, the dry mat being then at the bottom, and placed upon a dry board. When, by this means, it has lost most of the whey, it may be covered with leaves and laid between two pewter plates to ripen. This cheese is very rich in autumn ; but if made in winter, must be preserved from frost.

Another plan is to hang some sweet cream in a wet cheese-cloth until it is tolerably solid, then place it in another cloth in a mould, with a piece of wood the shape of the mould laid upon it, and press with weights for a few days. After being thus pressed and turned twice a day, it will keep for some time and ripen.

A very useful cheese for a family consuming it quickly, is made as follows : The morning's milk is strained and aerated, and the temperature raised to 85°. About three table-spoonfuls of patent rennet are added, and the mixture is covered and left to coagulate. In about an hour and a quarter it will be ready, when it should be cut into small squares and left for the whey to separate ; when this has taken place, the latter should be baled out, and the remaining curds gathered into a cheese-cloth, and hung up by the four corners to drain. In a few hours it should be changed into a dry cloth, and laid in a cheese rim, about 8 inches in diameter by 3 to 4 inches in depth, which is stood upon a perforated board. A flat board, or follower, the size of the inside diameter of the rim, is then placed upon it, on the top of which two or three pound weights may be placed. Five gallons of milk will make one of these cheeses, and it should not be skimmed, or heated too much, or it will become hard.

"I. E. B. C.," of *The Field*, gives a capital formula for making BATH CHEESE. Three quarts of cold water are added to a gallon of new milk, and set with 2 to 3 table-spoonfuls of rennet. When the curd has thoroughly formed it is taken out with a skimmer, and laid *en masse* upon a sieve to drain. After a short time it may be put into a small cloth, and laid in a square vat made for the purpose—say 9 inches wide by 1½ inches deep, which is about the size the cheese will be. When the cloth is saturated and the whey does not drip freely it should be changed for a clean dry one, and having been thus changed three or four times it will become firm, and may be taken out of the vat and placed in vine leaves between two dry pewter plates. Nettle leaves will do equally well; but in either case they must be changed daily, and with proper management the cheese will be ready in 8 or 9 days.

We have it on the authority of Mr. X. A. Willard, that Messrs. Burrell and Whitman (who hold the patent on the machine for emulsifying fat in skimmed milk, or the making of artificial cream) have adopted the method of manufacturing only first-class imitation cheese. In Canada there is only one factory; but in the United States there are several, viz. the Fink's Basin, making 18 cheeses per day; the Middleville, 11; the Newport, 9; the Coldbrook, 7; and the Eureka, 7—or together, 52 cheeses, averaging 60 lbs. each. Mr. Brown, the reputed whole-milk cheese-maker, is manager of three of these establishments, in one of which butter is also made. Artificial cream is a product obtained by passing one part of oil and two parts of skimmed milk, of a temperature of 130° Fahrenheit, through the Cooley machine. The oil used for this purpose is doubly refined cotton-seed oil, which is almost or quite as good as olive oil, much cheaper than oleomargarine or lard, and in other respects preferable to these two latter ingredients. Next, the skim-milk is heated to 94° Fahrenheit; then the buttermilk is added, and afterwards the artificial cream; the whole being thoroughly stirred, and brought to a temperature

of 90° Fahrenheit. Sufficient rennet is then added to cause coagulation in 8 minutes, when after 18 more minutes it is cut up horizontally and perpendicularly into very small pieces. After 40 minutes the curd is heated to 97° Fahrenheit and stirred by hand, except at the Newport factory, where Wise's self-agitating cheese-vat is used. The stirring and heating occupy about half-an-hour, or three-quarters, according to the condition of the curds. The temperature required at the second scalding is 100° Fahrenheit. The mass is then only occasionally stirred until the whey begins to change or turns slightly sour, when it is all drawn off, and the acid allowed to develop in the curds. Next, 2½ lbs. of salt to 1000 lbs. of the original milk are mixed with the curds, which are brought to a temperature of 85° Fahrenheit, placed in the press, and further treated in the usual manner. Since the above was written Mr. Lawrence, the inventor of the milk-cooler, has introduced a machine for mixing oil and milk. This he calls the Lactoleofract.

As dairy-work can be done better by machinery than by hand, some of the above-mentioned factories have been fitted with all the most approved appliances, many of which are worked by steam power.

At the White Creek Cheese Factory, Newport, Herkimer County, New York, cheese is made in the following manner: As soon as the evening's milk has been delivered at the factory, it is well aired and brought to a temperature of 70° Fahrenheit. The morning's milk is run into the vat, and the cream put through the strainer with the last messes before setting. The temperature is reduced to 48° Fahrenheit, and sufficient rennet added to ensure coagulation in 15 minutes. When cut horizontally the curd will break smooth over the hand, and after being left until the whey begins to separate, it is cut perpendicularly into small pieces. It is then allowed to settle, gently turned, and twice heated, with an interval of one hour, the first time to 90° Fahrenheit, and the second time to 98°

Fahrenheit. When the acid begins to develop, the whey is drawn, and the curd turned and placed in a vat to drain. It is then passed through the curd-mill and salted, 3 ozs. of salt being used to 100 lbs. of milk; after which it is pressed for one hour, turned, pressed again, taken out after 24 hours, and then cured.

RENNET.—The illustration (Fig. 16) shows the rumen (A B) and other portions of the stomach of the calf, that at F being the fourth stomach, from which the rennet is made. There are various

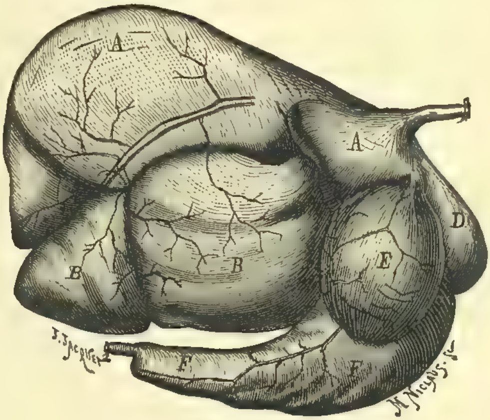

Fig. 16. Stomach of the Calf.

methods of preparing rennet in every cheese-making country, which it is unnecessary to describe further, but it may be remarked that Soxhlet has demonstrated the efficacy of adding a quantity of boracic acid in the preparation of rennet, as he declares that more than 10 per cent. of salt cannot be used with good effect. According to his formula, 40 grammes of the acid, 50 grammes of sea-salt, and 100 grammes of the calf's vell are added to every litre of water, and in a few days, another 50 grammes of salt are added to the liquid. After certain *modus operandi* the rennet is ready for use, and is of such a strength that one part will coagulate 10,000 parts of milk. A rennet of similar strength and of equally

valuable properties is made by the addition of alcohol instead of the boracic acid. Professor Soxhlet states that, if only for chemical reasons, rennet should never be used which has a coagulating force of more than 18,000, inasmuch as, when concentrated, it loses in two months 30 per cent. of its power.

Pouriau has given a list of the principal Continental makes of rennet, one of which, that of Ziffer of Berlin, which if used at a temperature of 91° Fahrenheit, will in 40 minutes coagulate 19,500 times its volume. The rennet known as *présure* Boll, which is really that of Hansen, the Danish maker, is equivalent to nearly 10,000, while the well-known rennet of Visser of Holland very slightly exceeds 6,000. Hansen's rennet, as in England, is very largely used in France. It is agreeable both to the taste and smell, and is a clear white in appearance. It is stated to contain 18 per cent. of salt and a little of the essence of cummin seed. Of its unvarying strength we can personally testify. Pouriau, as professor at Grignon, drew up a table showing the time required for the coagulation of 100 litres of milk and the quantity of Hansen's rennet necessary; thus, 9 grammes or nearly $\frac{1}{3}$ of an ounce brings the curd in 45 minutes when the milk is at 91° Fahrenheit, and at 82° Fahrenheit the curd is produced in 25 minutes by the use of 25 grammes or nearly $\frac{5}{8}$ of an ounce. It appears therefore that the lower the temperature the larger is the quantity of rennet required, and the longer the time in which the curd is forming the smaller the quantity necessary. Inferior rennet generally brings a badly-coloured whey which is often thick, containing a portion of the fat of the milk, whereas a good rennet produces a whey perfectly clear and green in appearance, in fact, just as it ought to be when the coagulation is perfect. A quart of this rennet will produce 17 cwt. of cheese, whereas if home-made rennet is employed, a number of vells will be required, costing at least three times as much, in addition to the labour entailed in converting them into rennet, and even then it will neither be so good nor so uniform. Without

going further into detail, it may be well to give a few words of advice to those who use, or are intending to use rennets of any kind. It must be remembered: (1) that the quantity of rennet used for coagulation of a certain volume of milk, and in order to obtain the curd in a given time, is in an inverse ratio to the temperature of the milk. (2) The richer the milk in fat, the larger the quantity of rennet required. (3) It will be noticed in the description of the manufacture of the various cheeses in another chapter, that where the use of rennet is referred to, a remark is sometimes made to the effect that the quantity used is undefined, being in accordance with the temperature of the milk and the weather, the quality of the milk and of the rennet itself; thus the length of time occupied in coagulating is in an inverse ratio to the quantity of rennet employed. (4) As coagulation is more easily conducted in summer than in winter, the quantity of rennet necessary is not so great in the one season as in the other. (5) It is unadvisable to use too much rennet, inasmuch as the curd becomes less cohesive, and much of the richness of the milk drains away with the whey, leaving the cheese dry and tough; on the other hand too little must not be used, for the drainage is not so complete, and much of the whey is left in the body of the cheese, giving it a bad flavour; the curd is also a much longer time in coming. (6) In making soft cheeses, the most favourable temperature at which to add the rennet to the milk is from 78° to 85° Fahrenheit; below 75° the curd is too tender, and the whey cannot be properly drained, while above 85° the former tends to become hard and leathery, and is more difficult to ripen. It must therefore be remembered that the temperature of the milk is of the utmost importance. As there is nothing more important in connection with cheese-making than a knowledge of the value of rennet, it may be stated in a few words how its strength may be tested, for of many samples, especially those which are home-made, it is impossible to tell the exact quantity which it is necessary to use, unless its strength is actually known. Let us

take Soxhlet's formula as our basis, and we shall find that this can be easily ascertained. Thus, supposing milk is tested as it comes from the cow, one part of a rennet of the strength of that made by Hansen, which is 10,000, would coagulate 10,000 times its bulk in 40 minutes, or according to Soxhlet, 1,000 parts in 4 minutes, whereas, if ten times the quantity of rennet be used, the same milk will be coagulated in $\frac{1}{10}$th of the time, *i.e.*, in 4 minutes. Bearing this fact in mind, it is possible, by a simple experiment with a small quantity of milk at the above temperature, to ascertain the strength of any rennet that is made.

CHAPTER XIII.

THE DAIRY.

We have adopted as the title of this chapter a word which is understood in all parts of the country to mean the apartment in which the milk is kept, or in which the manufacture of butter or cheese is conducted. Perhaps it would, however, be more correct to speak of the milk-room, the churn-room, or the cheese-room, as the case may be. During the last few years, and since the introduction of the deep-setting system, considerable modifications have taken place in the requirements of the dairy. For instance, where, under the open-pan system, two, or even three, apartments might be used, that in which the pans were stood can now be entirely demolished, for space, atmosphere, light, all so necessary to exposed milk, have little effect upon milk confined in the deep cans set in a refrigerator of cold water, which can with ease be placed in a corner of another apartment, even though it holds the milk of a large number of cows.

The size, position, and completeness of a dairy depends upon the circumstances in which a tenant is placed or the number of cows he keeps. A private individual keeping a few cows for his own pleasure, necessarily converts an apartment in his house into the milk-room, and, provided it is as suitable as could be expected, and arranged in accordance with the requirements of milk, no harm is done. A small dairy-farmer probably has a building or apartment provided, which was built with his homestead, and in a manner which was at the time considered very

perfect. With this he is compelled to put up; but, however useful he may find it, he will be able to add something to its completeness, and to improve it in some way with regard to ventilation and temperature. Upon a large dairy-farm the dairy should be as complete as science and money can make it, for upon the milk which passes through it depends the welfare of the farmer, and consequently of the farm, and it would be as idle to ignore the most perfect style of construction, as to deny the value of pedigree cattle, or the efficacy of artificial manures. Let us, then, consider what the requirements of a dairy are.

If a very small dairy is kept, the milk-setting apartment will form part of the general block, but it should be so arranged that it does not open into any other apartment from which smells, a different temperature, or moisture might enter, such as a bake-house or a wash-house; nor, indeed, is it wise to have it near the kitchen or scullery, although in Normandy it is a general practice to build the dairy immediately behind the kitchen stove; but this is done with an object. The French are fond of altering their temperature, and, although the milk-pans stand in trenches of running cold water, they have a communication with the kitchen flue, to admit a stream of heat into the dairy, which acts upon the milk in accordance with their wishes. A very small dairy is seldom built for the purpose for which it is used, but it can be adapted, in a great measure, in accordance with the suggestions we make farther on for larger dairies. In an ordinary farmer's dairy, which has no pretensions to be that of a dairy-farm proper, we would select, if possible, an apartment which may be described as a semi-cellar, and which we have often seen. It is generally at the back of the house, down several steps, with a window facing the north, and with its back wall built in the earth. The great inconvenience of steps is more than counterbalanced by the coolness of the dairy, and the saving of milk during hot weather. It is always a good plan, when arranging apartments for a dairy, to admit of a

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passage, or small ante-room, between the milk-room and the churning-room, that direct contact between the atmosphere in the one and the milk in the other may be avoided.

The following diagram will show more clearly what we mean :

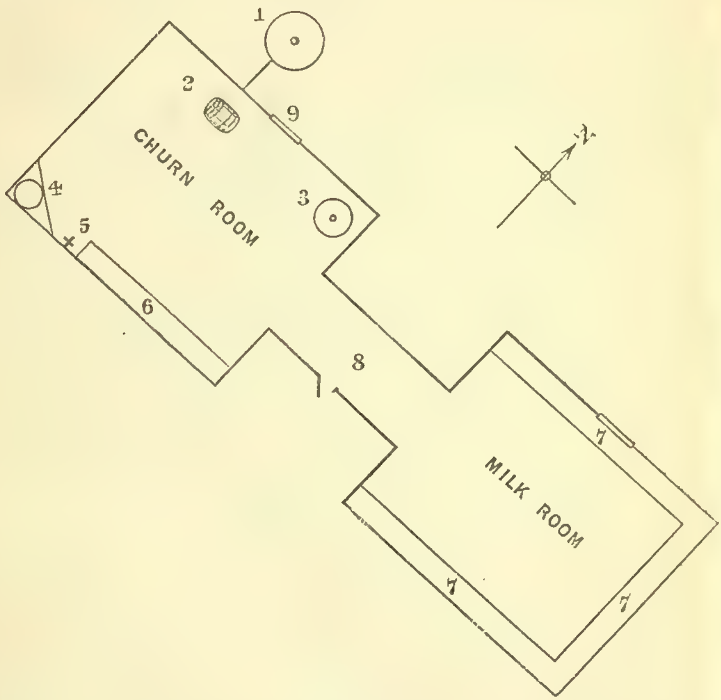

Fig. 17. 1, Horse-gear for Churning ; 2, Churn ; 3, Butter-worker ; 4, Copper ; 5, Cold Water ; 6, Bench ; 7, Benches for Milk-pans ; 8, Passage between the two Apartments, with Racks for Pails and Pans on each side ; 9, Windows facing North.

There are many little matters to be arranged, even in a modest dairy of this kind. In the milk-room the pans can be set upon benches or shelves attached to the walls, and the table in the centre can be used for the utensils, cream-pan, etc. There should be ventilators in each wall, and one in the centre of the

roof, while a plan of draining should be arranged, so that in washing the floor a sink would not be necessary, for although it may be trapped, it is most objectionable in the presence of milk. In no case should there be a window facing the south, but should this be unavoidable, it must have a hood or verandah, which, however, will not prevent much damage by the summer sun and hot air. On the north side the windows should be of very fine wire, that air can be at all times admitted, but insects never. The passage or ante-room leading out of the milk-room will be most useful for many purposes, especially for milk-pails and cans and other utensils. In the churn-room will be ample space for

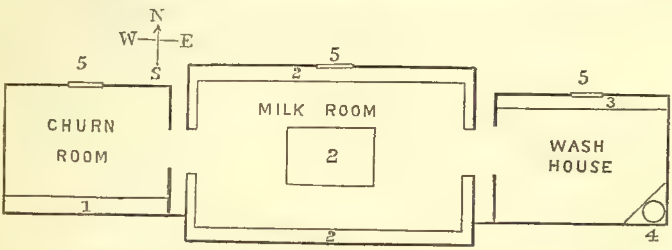

Fig. 18. 1, Bench for Butter-making; 2, Benches for Milk-pans; 3, Bench; 4, Copper; 5, Windows facing North.

the churn, which can be connected with an arrangement for horse-power outside if necessary, for the butter-worker, a bench for making up the butter upon, together with a copper, and every necessary appliance for cleansing the milk-vessels and implements. If there are three apartments, it may be found convenient to arrange them in a manner similar to the plan shown above (Fig. 18).

Here the milk-room is completely isolated, passages dividing it from the wash-house and churning-house, while it can be entered without going through either. In this case, however, the churn and butter-worker with the butter-making utensils, would have to be washed in the churn-room, or at all events, the two large implements.

We may now say something with regard to dairies for the largest kind of farms, and here let us remark that we think none so valuable as those which are isolated, sufficiently removed from the cows to prevent any possible contamination of the milk with the odours of the byres or cow-yard, yet near enough both to these and the house to be convenient. We have had the advantage of inspecting a large number of first-class dairies, and our suggestions are in a great measure based upon what we have seen, and perhaps we should add, also upon what we have not seen. Let us suppose that a dairy-farmer with a large number of cows, wishes to build a new dairy suitable for cheese-making, he would, if he preferred an isolated building, find the above as suitable as anything he could design, and even though he chose to attach it to his residence, he would find little to alter. By building the cheese and churning-rooms behind the milk-room, which is made to face the north, it is almost entirely protected from the sun, whereas, the arrangement is as convenient as could be wished, and no room is wasted. The above is so designed, that it is suitable for either a large cheese or butter dairy, or both; and, inasmuch as the variable price of cheese, and the fact that all cheese-makers make butter of some kind, necessitates a very regular use of the churn, we think that every cheese-dairy should be fitted so as to enable the farmer to make either the one or the other at will. In the milk-room the milk-pans may stand in a water-trough or shallow tank on the Norman plan. English shallow pans will not be suitable, but that should not be an objection. The water must be laid on so as to be continually running in at one end and out at the other. A window is in the centre, and this should be a double one, both sashes being well glazed. In the centre is a table or stand for the cream-pans, or there can be no objection to their standing upon the floor. At each end are ventilators near the floor, while in the roof, in the centre of the apartment, is another, thus conducting a continual flow of air through it. At one end is a

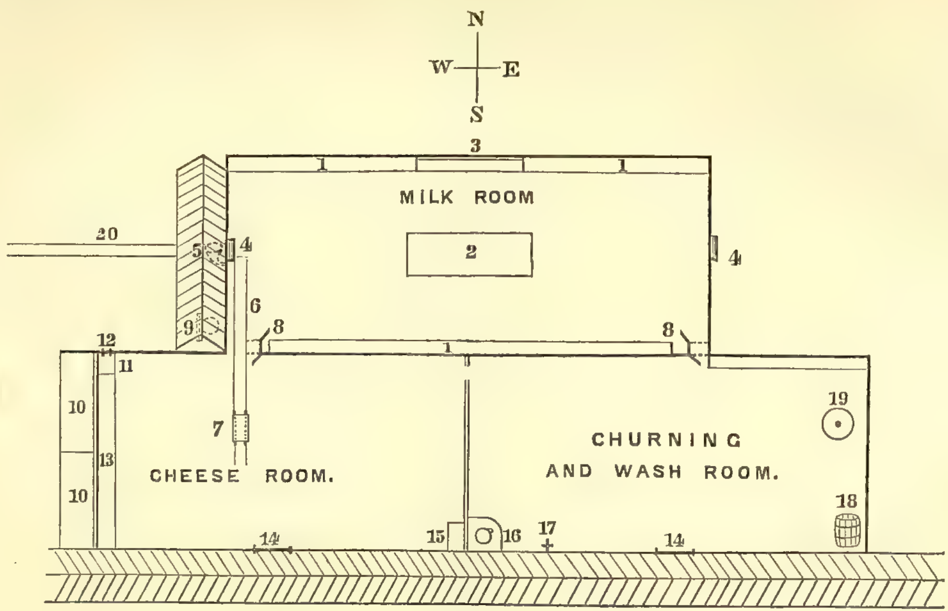

Fig. 19.

1. Milk Benches.
2. Cream Table.
3. Double Window.
4. Ventilation.
5. Receptacle into which men pour the milk for Cheese Vat.
6. Tramway.
7. Cheese Vat.
8. Double Doors.
9. Milk Cooler under shed.
10. Whey Vats (outside).
11. Lift, leading into curing or store-room above.
12. Window through which Cheese is delivered to carts.
13. Bench.
14. Doors leading into covered passage, under which an engine runs on rails.
15. Cheese oven.
16. Copper.
17. Cold water.
18. Churn.
19. Butter-worker.
20. Tramway for milk.

tramway, which runs through double doors into the cheese-room. This is intended for the large square vat, into which the milk is poured, and in which the cheese is made. The milkers never enter the dairy, but run the milk along the tramway (20), and pour it into a tube, which passes through the wall of the milk-house, whence it falls into the vat through a strainer at the end. By the side of the tube is the milk-cooler, over which the milk passes before being sent into the vat. This end of the building is covered by a verandah, to protect the cooler and the milkers while the milk is being manipulated. By this plan, when cheese is being made, the vat is filled at night, allowed to stand, and the morning's milk added, when it is wheeled into the cheese-room, and the operation of making commenced. If butter is being made alone, the milk can still be poured through the tube, the only difference being that another person will be necessary within, to hold each pan until it is filled. We now come to the milk-room, which is reached by the double or porch doors in the corner. We give no dimensions, inasmuch as it is easy for each person to arrange those for himself. As the operation of cheese-making is usually conducted in the middle of the room, the vat is run into the centre in the plan, and it need go no further. In the left-hand far corner is a lift for sending the cheeses up into the store-room for ripening, while by its side is a window, through which they are delivered to the merchant when sold. This is a somewhat necessary and important arrangement, as the best English cheeses are very large and heavy, and would be carried with difficulty; whereas, sent down by the lift, the window is merely opened, and they are rolled or slid into the waggon which is to carry them away. By the side of the lift is a stout bench, which will be found very necessary, and in the near right-hand corner is the cheese-oven, which is conveniently placed at the back of the boiler, in the next apartment. On the south side of the room stand the presses, and on the north side the stools, on which new cheeses are stood to drain. On the east side will be

found room for the curd-mill and the cheese-hoops, salt-box, etc. Outside this apartment, and at one end, is a little apartment in which the whey-cisterns are placed. These are built of slate, and fixed in the ground, being connected with the vat by a movable india-rubber pipe. When the whey has been skimmed, it is run off into a reservoir, which is built conveniently near the piggery. The churning-room is entered from the cheese-room by a door in the north-east corner. In this apartment the whole of the utensils are cleaned—for boiling water is always at hand—and the butter is churned. In the north centre is a double door, connecting with the milk-room; on the right of this is the bench for making up the butter; at the end, and close at hand, is the butter-worker; while in the south-east corner is the churn, connected with horse-power outside, if necessary. In the other corner is the boiler or copper, and near at hand the utensils should be kept and cleaned. There are doors connecting both the cheese-room and the milk-room with the passage outside, which is covered with a verandah, and in which all the utensils are stood to dry. If an engine is kept, it should be placed here, and either fixed in connection with the boiler within, or run along a tramway the full length of the passage, to be utilised for turning both churn and butter-worker, steaming the pails and other utensils used for milk, heating the cheese-vat—a most necessary operation—warming the milk-room in winter, and preparing food for the stock. Over the cheese and churning rooms should be an upper room, for the storing and ripening of the cheese. It should be of large size, for the cheeses are generally laid upon the floor, in preference to being stood upon shelves, as they are in most of the factories.

If the dairy is solely a butter dairy, the same buildings will do if slightly modified in size and arrangement. The milk-room can be fitted with the running water almost the whole way round, or it can be furnished with benches for open pans, with a table or stand for cream in the middle. Another plan would enable the

farmer to do with a still smaller room. We allude to the adoption of the revolving tables or shelves. Four of these, with three tiers of shelves each, would take a large dairy, and still occupy very little room. In a butter dairy there would be no necessity for the vat tramway, hence we should prefer to do with one door to the milk room, that leading to two others, belonging to the churning and washing-rooms respectively, this being in the centre. There would be no necessity for the whey-shed, and the cheese-room would be converted into a churning-room, with butter-making bench, butter-worker, churn connected with horse power, weighing machine, and all complete. The other room would be solely a washing-room, with boiler, copper, and hot-plate for scalding the cream when necessary, racks for the pails, etc. If the skim-milk is intended for pigs, an arrangement should be made by which it can be passed from the dairy, together with the buttermilk from the churn, into a tank; but if it is to be made into cheese, then a modification of the above plan of a cheese dairy should be made.

We now pass on to the construction of the buildings, and, while we leave the specifications to those whom they concern, we feel it necessary to say something respecting the material of which the apartments should be built. It must be remembered that in building, great attention must be paid to temperature, which should at all times be as equable as possible; hence, the walls and roof should be constructed to this end. We have always believed that brick is the best material to use; stone being more absorbent, at all events in the majority of cases, whereas it does not dry so quickly as brick, and a double, or hollow, wall cannot be made with it so easily. We advise then a hollow brick wall, so that, if ventilation is good between, the inner wall is almost certain to be at all times dry. It should be well finished, both within and without, the latter being carefully pointed with cement. For the roof, we cannot recommend thatch, as it is a harbour for birds and vermin, and is not lasting. Tiles cause a variable

temperature below, but, if perforated Staffordshire tiles are used, this may be obviated, as a current of air passing through them will keep them cool. Slates are durable, and resist the elements better than tiles, especially if they are thick and good. In any case, a ceiling will be necessary underneath, and this should be curved, so that no angles or corners will exist and form attractions for insects and dirt. Perhaps the most important part of the milk-room is the floor, and this should be constructed of a substance which is the least absorbent. Bricks or tiles are objectionable, seldom fitting very closely, and always being damp, and consequently imparting cold to the milk when it is not needed. Victoria stone, in large slabs, jointed with cement, and slate, well laid over concrete, are better than either. The late Bishop of Llandaff found that, whereas tile absorbed one-seventh of its weight, slate absorbed only one two-hundredth, and was dry, after wetting, in a quarter of an hour, if exposed to a temperature of 60°; whereas, the tile had not lost its moisture in six days. Wood has been used, but is, again, too absorbent, although it can be kept very nice. A fine cement or concrete floor may be made very useful, or, if expense is not a momentous question, glazed tiles, laid in cement, will prove better than anything we can recommend. These tiles are often used for the walls, and nothing can be better whether for appearance or utility; but, in ordinary dairies, a plain, well-finished, white-washed wall will answer all purposes. There should, in all cases, be ventilators, such as we have before mentioned, such as will carry a current of air through the apartment from floor to roof; and there can be no better plan than well-arranged apertures through the double wall at each end, with another in the centre of the ceiling. We have dwelt upon the systems by which the dairy may be cooled in hot weather, and it may be useful to mention that, as many persons prefer that it should not get below a certain temperature in winter, this can be prevented by the use of hot-water pipes, which are not costly, and are easily worked. Although we do not believe in the large use

of cold water in the milk-room, yet it is as well to have it laid on by a small tap. Drainage should be very carefully managed, and the best plan by far is to lay the floor so that it has a slight fall towards the next apartment, into which the water can run by a small gutter, and whence it can pass away through a trapped sink.

The doors should in all cases be double, provided with springs to keep them shut, and draught-proof stops. The windows should be carefully constructed; the outer one of fine wire and the inner one of glass, so arranged, in three pieces, that the under pair—hung in the ordinary way—can be opened to any degree right or left, according to the weather or the direction of the wind; while the upper one, hung crosswise, will direct the air up or down as is found necessary.

If the Norman system is adopted, the water trough will be of the same material as the floor; but if the shallow pan is used—and English people unwisely prefer this—then shelves will be necessary. We have seen them of wood, metal, brick, tile, marble, stone, and slate. Marble is to be preferred, but it is expensive; encaustic tiles are also good and agreeable; but slate or sycamore wood will be found the best, when economy is to be combined with utility. In all cases, a little space should be left between the shelf and the wall for a free draught of air.

For the cheese or butter rooms there should be ample ventilation; good sycamore shelves, with a marble slab for making up the butter; trapped drains, and concrete floors.

CHAPTER XIV.

DAIRY UTENSILS AND APPLIANCES.

It is no uncommon thing for those who write upon dairy matters in the agricultural press, to receive letters of inquiry or advice as to the utensils necessary in a dairy. "What shall we need?" say the querists. "What prices must we give for churns, pans, pails, etc.; and where shall we procure them?" These questions all show how real is the necessity for such a work as this, and how difficult it is to answer them through the medium of a newspaper. Without entering into a dissertation, it is generally impossible to say exactly what is wanted, because reasons are often necessary; and, although quotations can be taken from the prospectuses of the chief makers, yet there are manufacturers of specialities who issue none; and, in any case, it is often impossible for an editor to recommend a particular article, when there are so many makers upon the same level.

In this work, we propose to describe the appliances in use, whether in large or small dairies; in fact, without any reference to any special case, or any particular maker; as, with the assistance of our previous remarks upon the management of the dairy and the manufacture of butter and cheese, any reader will be able to choose for himself. As a good workman always demands the best of tools, so we think that to carry out dairying to perfection, the appliances should be both complete and perfect, and then with good management, inferiority and loss will be discounted and perhaps entirely averted.

Churns.

The *Victoria* (Fig. 20) is a particularly good barrel churn, and revolves in a manner quite contrary to the old principle, turning

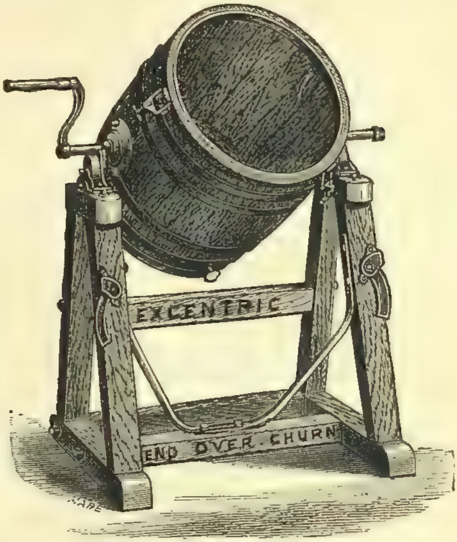

Fig. 20. Victoria or Excentric Churn.

end over end. It is made in all sizes, and is simple in construction. There are no dashers or beaters whatever, and the opening is at one

Fig. 21. The Swing Churn.

end, which has a loose lid, so fitted as to prevent any waste of cream. It is easily cleaned, and the butter is manipulated without any

trouble. We cannot speak too highly of this churn, although, as it were in proof that there is nothing new, the End-over-end system, known chiefly in connection with Waide's churn, is found in a capital machine upon this principle, by Burchard, in Sweden. Indeed the Victoria is but an imitation.

The *Swing* (Fig. 21), or *Oscillating* churn is a more recent idea, and is most efficient. It has an oscillating motion, the cream coming in contact with the walls of the churn only. It is cheap, easily cleaned, and does its work well.

The chief advantage of churns of this system, and it is a most

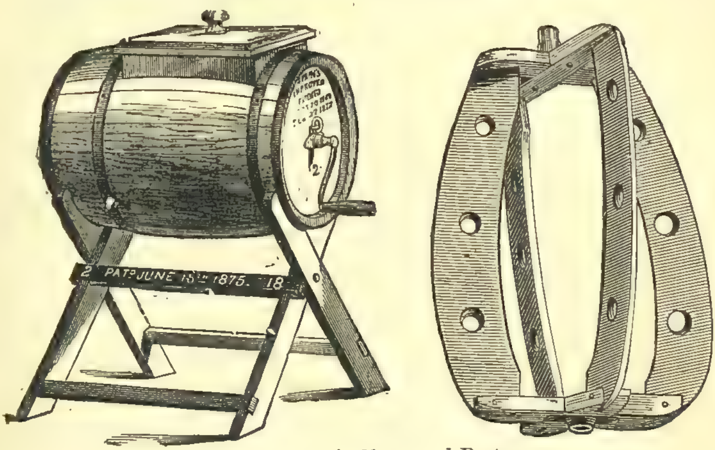

Fig. 22. Spain's Churn and Beater.

important one, is that the butter is not beaten into a lump when it gathers, but forms into granules; consequently, it is more easily cleansed, it is sweeter, and its grain is entirely preserved.

Hathaway exhibited a new churn at the Royal at Reading, and again at the London Dairy Show, where it won the prize in the churning competition, obtaining first-rate butter in 7 minutes. It is a long churn, similar to the swing, without beaters, but it has two motions, an oscillating and a revolving. There can be no doubt that it has some merit, and we believe it is exceedingly cheap.

The *Spain* (Fig. 22) barrel churn is similar in appearance to the

ordinary barrel, but it is stationary. The work is performed by the revolution of a dasher within, which is worked by the usual side handle. The internal arrangement permits of the dasher being easily removed through the large lid at the top. There is no waste, and the churn is easily cleaned, which many barrels, as we know too well, are not.

The *Declivity* is a plain box churn, more suitable for a small family than a dairy. It is cheap, fitted with an ingenious lid, spigot, and dasher. Some of the box churns have zinc linings and cavities, for the reception of cold water; but this is seldom necessary.

Richardson's *Barrel* has done good work, and is made in sizes suitable to the largest dairies for two men or power. It is fitted with a bung of metal, and an indiarubber flange, through which the cream cannot escape. The churn is made of oak, and is easily cleaned. The prices are reasonable.

The *Eccentric* churn (Taylor's), is another novelty, which has not long been before the public. It has two actions, one similar to the rotary action of the barrel, and another which is due to the shape of the vessel itself and its diagonal axis, and which throws the cream from end to end. This churn is very popular in some districts, and we have seen it used with every success in some of the largest establishments, notably in Lord Vernon's factory.

The *Rocker* is in the form of a box, 2½ feet long by 1 foot deep, and 1¼ feet wide. In the centre is a rack with perpendicular bars, which fits into grooves in the sides of the churn, so that it can be removed. There are also two rockers fitted lengthwise, so that the cream, every time it is rocked, passes through the rocker; and, as it can be worked by the foot, something else can be attended to at the same time.

The *Atmospheric* (Fig. 23) is a tin cylinder, which is worked by a plunger, the lower half of which is hollow and perforated; at the bottom is a disc, also perforated, and a trifle smaller in diameter

than the churn itself. When working, the disc is always below the surface, and when it is brought up, the air finds its way into the vacuum beneath, through the holes in the tube or hollow half of the plunger. This churn can be placed in hot water when necessary. It is cheap, but not so substantial as the best wooden ones.

The Canadian churn, the *Figure Eight*, is quite a new one. Its peculiar mechanism gives it a high velocity, and a current of air is continually passing through it, by means of two tin bell-mouthed tubes in the lid. In the centre of the lid is a piece of glass, which immediately denotes the presence of butter, while another improvement enables the butter to be completely separated from the butter-milk with rapidity. When a public trial of this churn took place last year at Skipton, although under most disadvantageous circumstances, 7¼ lbs. of butter were produced from 19 lbs. 4 ozs. of cream, in 3 minutes 25 seconds, too rapid work, however, to obtain a good result.

Fig. 23. Atmospheric Churn.

The newest of Llewellyn's churns is the "*Excentric End-over*," which is upon the same system as the Victoria, except that it has diagonal action. It has no dashers or beaters at all, and one end takes off entirely, so that it is cleaned perhaps as easily as Waide's machine. In the lid is a glass indicator, which is an additional advantage. The Excentric is made of oak, and fixed upon a large or small stand, according to its size; it is strong and plain, yet its finish gives it the appearance of a handsome addition to the dairy.

Hathaway's *Improved Barrel Churn* is a good one, and has repeatedly proved its value in competition. At the Oxford meeting of the Royal Agricultural Society—a competition in which many churns were entered—it took a very high position, bringing 15 lbs. 3 ozs. of butter, from 12 quarts of cream, in 10 minutes, distancing all others in both time and quantity. The beaters are upon the Archimedean principle, and increase the agitation; while the stopper, which is fixed by a solid steel strap, is most simple and effective. The churn is readily cleaned,

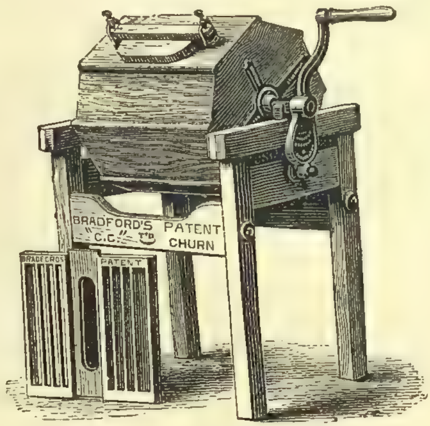

Fig. 24. The "C. C." Churn.

and the butter can be manipulated with the greatest ease. It revolves on anti-friction rollers, and is well finished throughout.

The *Blanchard* is one of the best and cheapest churns made. It resembles a box upon four legs, the top being square and the bottom rounded. The top takes off and the beaters can be removed, so that the whole thing is under perfect control, and can be cleaned with a facility which is not surpassed in any churn we know. It is much used in America, and is specially imported by the Dairy Supply Company.

Bradford's have long been known as the makers of good churns, and their *Midfeather* and "*C. C.*" (Fig. 24) machines have

had a large sale. The former is a strongly-made revolving churn, fixed upon a powerful stand, and working upon *lignum vitæ* bearings. It is very easily worked, and has taken high positions in many competitions. The "*C. C.*" is a similar churn, but is fitted with a movable dasher, which is made so that the whole of the cream will be subjected to equal agitation. The dasher is diagonal in formation, and as it is claimed that it gives a series of converging currents, the initial letters of these words have been used for its

Fig. 25. The Holstein Churn.

name. The last new churn of this firm is the *Diaphragm*, which is an octagonal barrel-churn, but its essential principle differs from that of any other barrel. It has no internal dash or breaker, but simply a plain board, or diaphragm, which divides it into two compartments. There is, however, a clear space on each side of the division, which allows about one-fifth of the milk or cream to roll round the whole churn, while two-fifths are retained in each compartment, rolling round one half of the periphery, and shooting down the diaphragm at each turn of the churn. The effect is singular when witnessed through a glass model, which shows

clearly enough that the idea is a first-rate one. This fixed division also diminishes the power required to nearly one-half, which is an important feature.

The *Holstein* (Figs. 25 and 26) churn, made by Ahlborn, of Hildes-

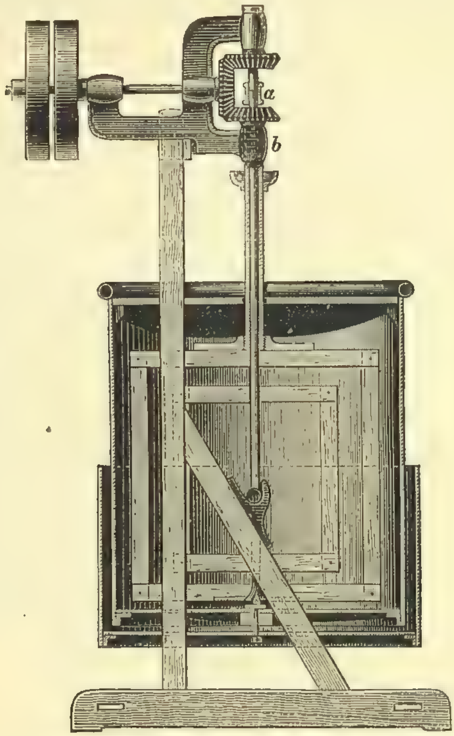

Fig. 26. The Holstein Churn (large size, showing the interior).

heim, is universally known, and we have seen it in use in France, Germany, and England. It is a fixed tub, larger at the bottom than at the top. A vertical rod runs through the lid into the milk or cream, and on to this are affixed the beaters, which revolve at much greater speed than those in ordinary churns. The churn is worked by a small handle at the side, and is also adapted to steam.

The *Pavy* churn (Fig. 27), which we first saw at one of the French Dairy Exhibitions, where it was awarded the gold medal, is made by M. Pavy, of Alençon, in the Department of Calvados. It is triangular in shape, and is furnished with a gate-like dasher which slides easily out of the mouth. The lid is of wood, and is kept in place by a flat supple bar, also of wood, which is ingeniously fastened. This churn has already been imitated in England, where it naturally costs more money, the price of the French utensil being 70 francs.

Fig. 27. The Pavy Churn.

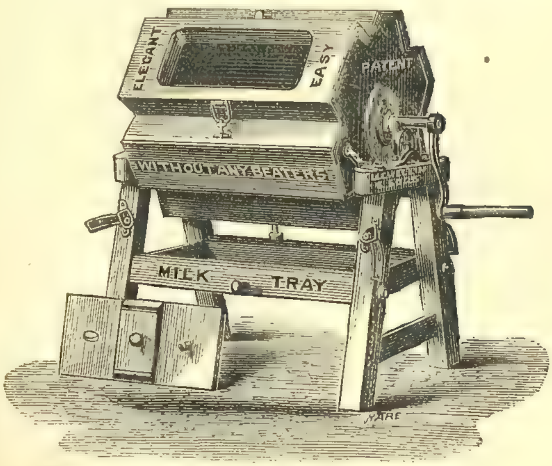

Fig. 28. The Merlin Churn.

The latest invention is the *Merlin*, a barrel churn, designed by the author of this volume. Having observed the working of the Swiss churns, which are something like a mill-stone in shape, large in diameter, but exceedingly narrow, we thought that an

improvement might be made by discarding the inside beater, widening the churn and providing a number of angles within. To this end it was designed in two forms, the periphery being in the one divided into a number of segments, each of which gave an angle within, thus providing beaters for the butter, while the curves between afforded the greatest assistance in cleaning. In the other, the angles were provided in a different manner. Instead of the curves between each angle, the space is built up with three sides, thus giving the ends of the churn the form of a "Star," under which name it was exhibited by the firm who made the pattern for us—at the London Show in 1882—but the writer being one of the judges of the competitions, its performance was simply noted. The churn is well made in oak or sycamore, fitted with a patent lid and vent, works upon anti-friction bearings, has loose handles for lifting, and a tray beneath, which is very handy.

Among systems of churning which are known on the Continent, are the following:

A box, in the form of a cube, is fixed upon a stand by two corners, and made to revolve. It has no beaters within, and the lid is large and convenient.

In Claës' *Belgian* churn, a deep metal vessel with a curved bottom, the beaters, attached to the shaft passing through the centre, are small narrow bars, 24 in number, and in 4 rows. At the side of the churn are 6 more, through which the 24 pass at every revolution. But for these, which are troublesome and difficult to clean, the churn is good.

A capital little churn is that known as the *Bretonne* (Fig. 30), and which is made by Savary, of Quimperlé, Finisterre. We saw this instrument at one of the large exhibitions in Brittany, and we believe it is sold in this country by some of the dairy-implement firms. It is extremely simple, and moderate in price. A bottle-like earthenware vessel is fitted with a piston, which is worked in a somewhat similar manner to that of the Holstein churn, except

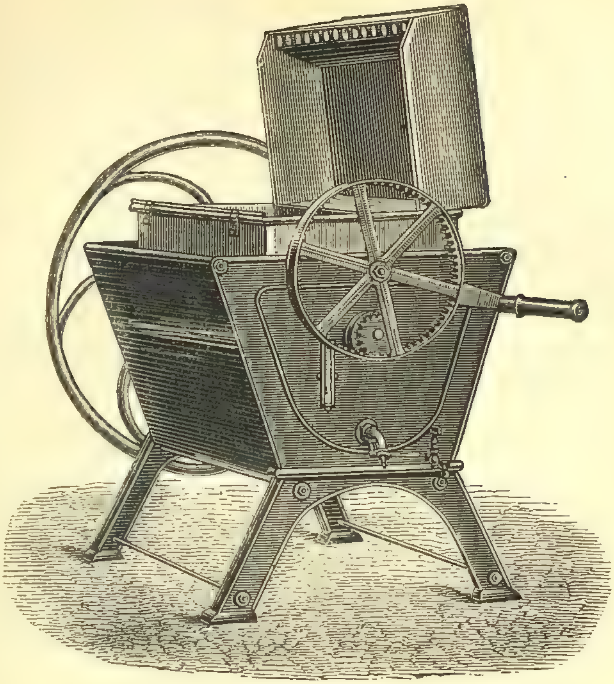

Fig. 29. Ahlborn's Churn.

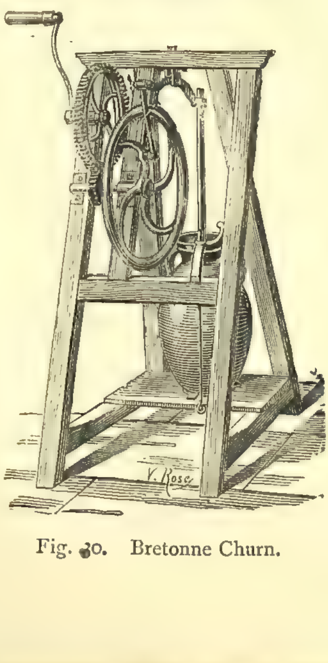

Fig. 30. Bretonne Churn.

that the movement of the beater is quite different. The machine is well adapted for a small dairy or a private family, although

Fig. 31. Brittany Churn.

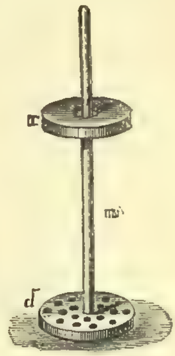

Fig. 32. Disc used in Brittany Churn.

larger makes are used upon many good farms in Brittany, where about 40 gallons of cream are dealt with at once. This is really an improvement upon the typical Bretonne churn.

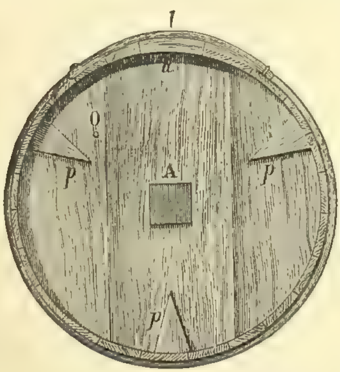

Fig. 33. Barrel of Swiss Churn.

An earthenware churn, as shown at Fig. 31, is largely used in Brittany. It is nothing more than an enlarged milk vessel (B) and is worked by the beater (Fig. 32), at the bottom of which (*d*) is a disc, while at the top is a covering (*r*), through which the rod (*m*) passes.

The Swiss, or millstone churn (Fig. 33), as it is called, and which is very quaint in appearance, is one of the worst in existence, although it is employed at the Agricultural School at Grignon in France. It is much used in North Italy, more especially in the Parmesan cheese district. But in the large

dairies, where hundreds of litres of milk are daily dealt with in the manufacture of a single cheese, the churns used upon this system are simply enormous in size. M. Pouriau speaks of one he saw at the Milan Exhibition which was 32 feet in diameter, while some of the Swiss and Italian farmers have churns as large as 4 feet 2 inches in diameter, and, indeed, we saw them of this size at the Swiss Exhibition.

A useful churn for a small dairy is that known as the *Valcourt*, which is simply a broad barrel of large diameter standing within

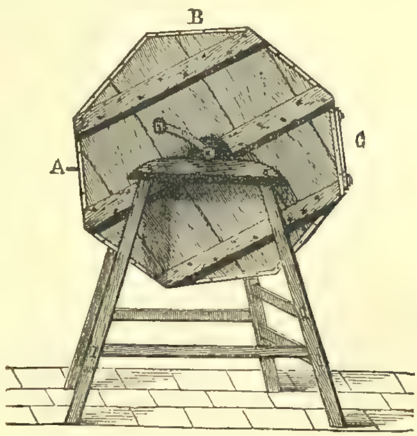

Fig. 34. Fouju's Churn.

a round wooden vat, and resembling somewhat, both in form and idea, a grindstone, the bottom portion of which stands in a vessel of water. There are two sets of beaters within, each having seven bars, and, when the churn is worked, it continually runs through the cold or warm water (as the case may be) which is placed in the vat, the object being to maintain the cream at a certain temperature.

Another good French churn (Fig. 34) is that made by Fouju, of Vernouillet, Seine-et-Oise. It somewhat resembles an octagonal barrel, except that it is much narrower than the

ordinary barrel churn, although its diameter is large. It has a dash-board within, which can be slid in and out at will, and there are two sets of three apertures cut across it for the cream to pass through. There are three openings into the churn—one

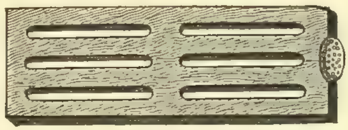

Fig. 35. Dasher (Fouju's Churn).

for the admission of the agitator, another for the cream, and a third for letting out the gas as it forms during churning. We remember to have seen this churn worked with considerable effect at the French Exhibition at St. Lo. Its price varies from 16*s*. to £5, for from 3½ quarts to 20 gallons of cream can be used.

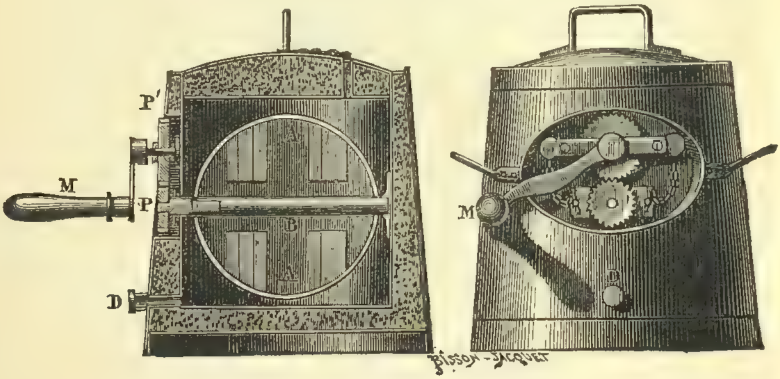

Fig. 36. Pouriau's Churn.

In a similarly made churn—that of Chappellier, of Ernée, Mayenne—there is a tube inserted within for carrying a thermometer, an idea which most churn-makers have found difficult to carry out.

The amiable author of "*La Laiterie*" has given his name to a churn (Fig. 36) which is called the *calfeutrée*, or "stopped up"

churn, presumably because the exterior air is kept from contact with it by means of a padding of felt which is placed, to a considerable thickness, between the outer and the inner cases of the utensil. It is ingeniously made, and worked by means of a pinion. The form is similar to that of a bucket, except that the diameter of the top is smaller than that of the bottom. The beater within is made upon the American principle, and the cream, when placed in the churn, maintains its temperature the whole of the time of the operation, supposing it to be normal. It is manufactured by Huard *aîné*, Paris, and costs from £1 16*s*. to £7 12*s*., according to its size.

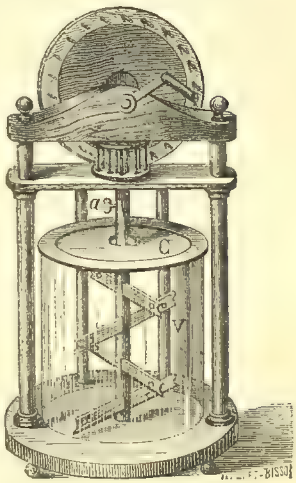

Fig. 37. Glass Churn.

The illustration (Fig. 37) shows a churn, the vase or drum of which is made of glass (V). It is, naturally enough, only made in small sizes suitable for a half to one-and-a-half gallons of cream. In use it is generally filled to the extent of two-thirds, and worked at a temperature of 54° Fahrenheit in summer, and 57° Fahrenheit in winter; but we believe it is a fact that it is often very necessary to churn for a considerable time before the butter comes, as the cream is not sufficiently agitated by the beater within, which is by no means so well adapted to the work as it might be.

Another churn resembles a box, about 3 feet by 20 inches. It has a sort of gate across the centre, and stands upon a pair of rockers. There are handles at each end, and by these it is rocked until the butter comes. It has a large lid, the gate slides out, and it is manipulated and cleaned with ease. It would be difficult to devise a simpler or more inexpensive churn than this.

At all times, and in all countries, new ideas have been formulated in the manufacture of churns, but more attention appears to have been devoted to ingenuity than to simplicity, for

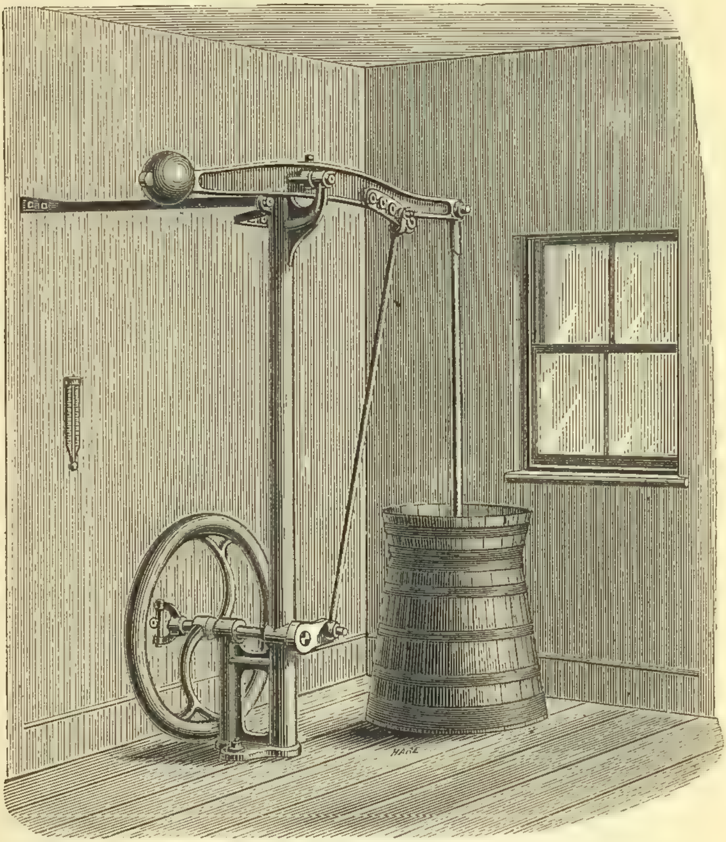

Fig. 38. Pierce's Irish Power Churn.

it is the cheap, easily cleaned, and simply constructed machine that is alone wanted.

Of the competition to which we have referred, we are enabled to furnish some useful memoranda, which we took at the time and published in the *Field*. The competing churns, suitable for

40 quarts, were 7, and to two-thirds cream was added one-third milk. Points were awarded as below, for special features, and the 1st and 2nd prizes were in each case awarded to those churns which obtained the most. As will be seen, the winners did not in each case obtain the most butter; and the fact of the Excentric getting 2nd over Waide, shows faultiness in the scale of points. At the same time they will prove of much value to all who are interested in churns.

	Construction and Simplicity.	Condition of Butter.	Taste of Butter.	Weight.	Total.	Time in Churning.	Weight of Butter.
Diaphragm ...	9	8	7	7	31	20½ min.	11 lbs. 2 ozs.
Victoria	10	8	8	8	34	About 20 min.	12 „ 2 „
Star	9	8	7	8	32	16 min.	12 „ 2 „
Llewellyn's Barrel	8	7	7	10	32	18 „	12 „ 10 „
Excentric, 2nd ...	8	10	10	7	35	21½ „	11 „ 0 „
Richardson's Barrel	7	6	8	4	25	17 „	9 „ 2 „
Hathaway's do., 1st	9	10	8	9	36	23½ „	12 „ 8 „

In the competition for small churns, of which 9 competed, 10 quarts of richer cream were given to each, the temperature being 56° Fahrenheit; whereas, in the other competition it was at the high figure of 66° Fahrenheit. The following was the result:

	Construction and Simplicity.	Condition of Butter.	Taste of Butter.	Weight.	Total.	Time in Churning.	Weight of Butter.
Hathaway's Barrel	8	9	10	6	33	27 min.	4 lbs. 3 ozs.
Do. Rocker, 1st	10	10	10	10	40	9 „	4 „ 6 „
Diaphragm ...	9	8	9	9	35	27½ „	4 „ 5 „
Victoria, 2nd ...	10	10	10	8	38	24½ „	4 „ 4 „
Star	10	7	9	8	34	39 „	4 „ 4 „
Llewellyn's ...	10	8	8	8	34	34 „	4 „ 5 „
Excentric	9	9	10	9	37	20½ „	4 „ 6 „
Richardson ...	8	6	8	6	28	21 „	4 „ 5 „
Dairy Supply ...	6	8	9	5	28	17½ „	4 „ 2 „

Cream Separators.

The invention of separating the cream from milk by mechanical means, has wrought a great change in dairying on a large scale, and is of the utmost value. It enables a manufacturer to utilise his cream while it is yet warm, and to send his butter and skim-milk into the market in its freshest and sweetest state. By its aid there need be no more sour milk; while the skim may be offered to the poorer classes instead of to the pigs, as it too often is. The chief machines are the Danish, the Laval, the Lefeldt, the Petersen, the Fesca, and the Nakskov.

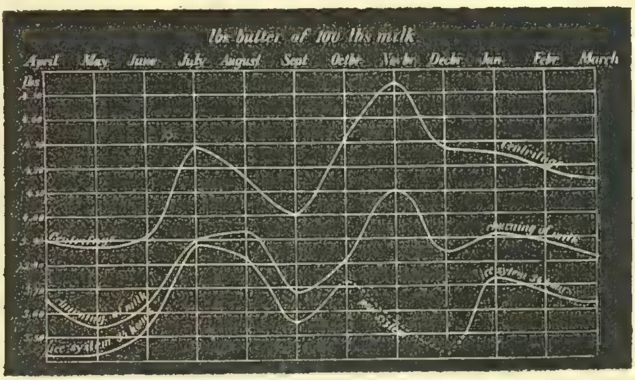

Fig. 39.

The value of the centrifugal cream-separating system as compared with other systems was conclusively shown by Fjord in his experiments, lasting over a year, particulars of which were published in Denmark in October, 1882. In all, 600 experiments were made upon milk of similar quality, the analyses being conducted by Professor Storch, manager of the Danish Agricultural Laboratory. There were made 187 analyses, 260 separator trials, and 251 churnings of milk, in which 133,000 lbs. of new milk were used. The diagram (Fig. 39) shows the quantity of butter manufactured per 100 lbs. of milk during the whole of a year

under three systems—the separator system, the churning of milk, and the system of raising cream in iced water, and, from first to last, the separator is shown to be far ahead. If, however, we look at the result in another light, we find that the average quantity of milk required to make 1 lb. of butter under the centrifugal system was 24·4 lbs. When the milk was churned, 26·7 lbs. were used; when the cream was raised upon the ice system in 34 hours, 27·5 lbs., and in ten hours 29·5 lbs., whereas, by the ordinary cold water system at 34 hours, the temperature being 54° Fahrenheit, 32·4 lbs. were required. In each case these averages were based upon the milk supplied at the farms where the experiments took place, but when the milk was purchased it required from 1 lb. to 2 lbs. more of milk per pound of butter. Upon the average of six experiments with buttermilk it was found that the percentage of fat left under the ice system was ·06, the water system ·09, the open pan ·08, and the separator ·05, while in 3 lbs. of butter, water was found upon the average of six months to the extent of ·48 under the ice, separator, and milk-churning systems, ·46 under the pan system, and ·47 under the water system.

The *Danish* (Figs. 40 and 41) machine, which is sold by H. C. Petersen & Co., of Copenhagen, is worked by centrifugal force, and will separate from 100 to 120 gallons of milk an hour. The percentage of cream to be removed can be regulated to the greatest nicety, and while the Laval revolves 5000 times a minute, the Lefeldt 2400 times, the Danish runs at only 2000 to 2500. Its cost at the present time is £75. The inside diameter of the milk drum is 25½ inches; the inside circumference is therefore about 6½ feet, and the surface speed required to separate the cream 9750 feet per minute, which is 5250 feet less than the Laval. At the Royal Show, at Derby, the average work done by this machine was 15 lbs. 10 oz. of butter from 15 quarts of cream; a very high standard indeed, especially as it was 4 lbs. 10 ozs. more than the Laval gave at a similar churning and in the same time. There is no doubt that the Danish is, in one sense, an improvement on the Laval; but the

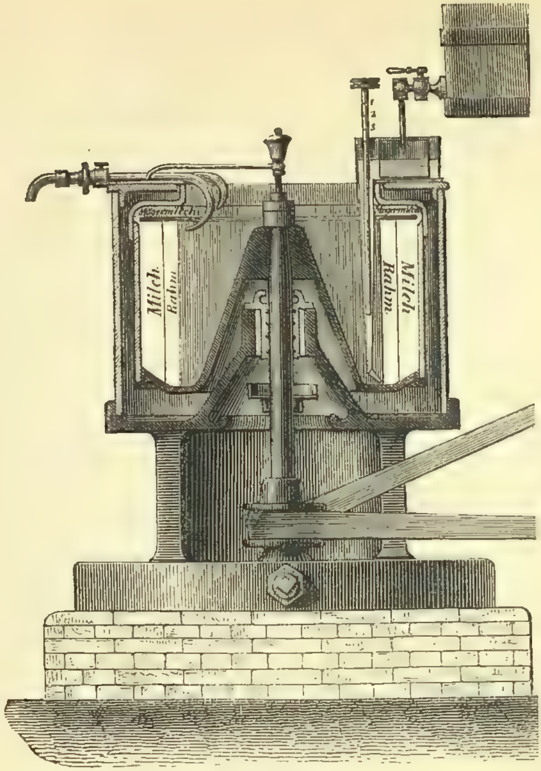

Fig. 40. The Danish Cream Separator. (Interior of the Drum.)

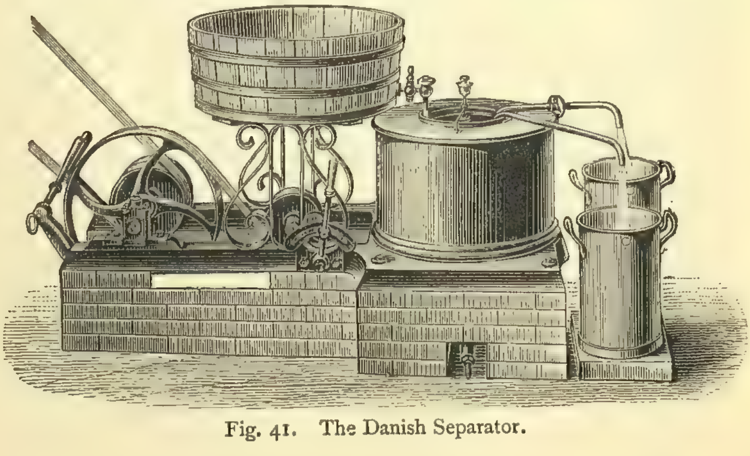

Fig. 41. The Danish Separator.

tube by which the cream is conducted after separation, can be adjusted so that the cream can be obtained of any consistency, without regard to the rate at which the machine is working. Mr. Alfred Smetham, F.C.S., gave the following interesting analyses, which were obtained from two portions of milk:

	"Laval," running 29½ galls. per hour.	"Danish," running 43½ galls. per hour.
Water	61·46	52·32
Fatty-matters	33·44	42·68
Casein, albumen, milk-sugar...	4·56	4·42
Mineral-matters	0·54	0·58
	100·00	100·00

The skim-milk obtained at the same time had the following composition:

	"Laval," running at 29½ galls. per hour.	"Danish," running at 43½ galls. per hour.	"Danish," running at 52½ galls. per hour.
Water	91·72	91·82	91·36
Fatty-matters ...	0·29	0·11	0·44
Casein, milk-sugar	7·22	7·32	7·41
Mineral-matters	0·77	0·75	0·79
	100·00	100·00	100·00

The power was unfortunately deficient, and it was found impossible to run the machines at their full speed; but, notwithstanding this drawback, it will be observed that the results in both instances were highly satisfactory. There can be no doubt, that by the aid of these machines, the cream may be practically and entirely removed—far more completely, in fact, than by the ordinary method of setting; and as, moreover, the cream and skim-milk are perfectly fresh, it will be apparent that in large dairies (especially those which supply towns) their use will become almost a necessity. The actual saving in butter-making, by reason of the more complete removal of the cream, will be very important, to say nothing of the indirect saving in the cost of pans and dairy-fittings.

Since writing the above we have been present at the Separator Competitions at the German and Danish Agricultural Exhibitions, where some new makes were exhibited, and whence considerable information with regard to the centrifugal system of cream separation was obtained. The Danish competition was perhaps the most complete ever held. The competing machines in the class for two horses or above, were those of Petersen & Co. (the Danish), and the Laval. There were two Danish machines in work, the A machine on a single bed-plate, and the AA on two bed-plates. The speed of the former was 2000, and of the latter 2100 revolutions per minute, while the power required

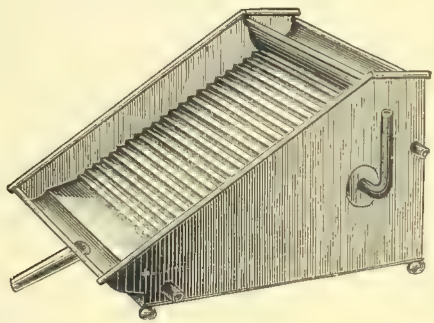

Fig. 42. Milk-warming Apparatus, as used with the Danish Separator.

for each was 1·3 indicated horse. These machines were jointly awarded the gold medal. In the class for separators to be drawn by one horse of common strength, or still smaller power, there were seven competitors: the Danish; the Laval; the Nakskov, shown by Tuxen & Hammerich; the Aarhus, shown by H. P. Jensen, of Aarhus; the machine of O. C. Petersen, of Copenhagen; of O. P. Petersen & Co., of Roskilde; and S. Berglund, of Salstad, Sweden. The three last-named did not compete, and after a trial the jury considered that the only other machines worthy of further competition were the Danish and the Laval. Further working took place with these at the farm of Vestervig, under the direction of Professor Fjord and his assistants, and,

perhaps, no experiments or trials were ever carried out in a more perfect or elaborate manner. Rotary and draught dynamometers were specially constructed to indicate the power consumed. The speeds were noted carefully every minute, and not only those of the vertical axles, but of the axle of the horse-gear, of the rotary dynamometers, and of the intermediate motion, each having affixed a self-registering indicator. It was finally shown that the speed of the Danish machine was 2000 to 3000 per minute, and that of the Laval 5000 to 7000. There were five working trials, each being carried out with 200 lbs. of milk for each machine. The skimming of the last contests was specially noticed. The Danish did this work well, and the Laval fairly well. The analysis of the milk taken from these trials was conducted secretly and in duplicate, the analysts concerned not knowing how the samples handed them for examination were taken. The experiments were tabulated as follows:—

				Degree of Skimming. Percentages of Fat left in Skim-Milk.		
	Speed.	Inflow.	Indicated H.-P.	Special Sample.	All Milk.	Calculated per hour.
1st Series: Same inflow, different consumption of power.						
Danish ...	2400	450 lbs.	0·63	0·25	0·21	0·23
Laval ...	5800	450 lbs.	0·81	0·23	0·23	0·23
2nd Series: Same inflow, different consumption of power.						
Danish ...	3000	700 lbs.	0·88	0·30	0·22	0·28
Laval ...	7000	700 lbs.	1·20	0·29	0·29	0·29
3rd Series: Same inflow, same consumption of power.						
Danish ...	3000	450 lbs.	0·81	0·14	0·12	0·13
Laval ...	5600	450 lbs.	0·81	0·23	0·27	0·25
4th Series: Same inflow, same consumption of power.						
Danish ...	2959	600 lbs.	0·83	0·23	0·17	0·21
Laval ...	5600	600 lbs.	0·83	0·38	0·36	0·37
5th Series: Different inflow, same consumption of power.						
Danish ...	2875	565 lbs.	0·81	0·21	0·17	0·20
Laval ...	5600	450 lbs.	0·81	0·24	0·25	0·24

Thus it appears that the Danish small machine skimmed 565 lbs. per hour, leaving 0·20 per cent. of fat in the skim-milk, and the Laval 450 lbs. per hour, leaving 0·24 per cent. of fat. Mr. Petersen claims as the result of the competition that at the same degree of skimming and by the same consumption of power the Danish "B" machine skims one-third more than the Laval; that with the same inflow of milk and the same consumption of power the Laval leaves 64 to 65 per cent. more fat in the skim-milk; and that at the same degree of skimming and with the same inflow of milk the Laval requires one-third more power. At all events, the Danish machine was awarded the Gold Medal. The price of the small ("B") machine of this make is £43, but it must now be termed the middle size, inasmuch as the makers have at last introduced a small separator adapted specially for the use of the British farmer, and for working with a horse or pony. This machine was first exhibited at the International Exhibition at Amsterdam, in September, 1884, and appeared in London at the Dairy Show in the following month. Having obtained this unique little separator, and, by its means, extracted the cream from 20 gallons of cold milk per hour, we are able to bear testimony to its value to the dairy-farmer, more especially as we have worked it with a pony of thirteen hands, and obtained skim-milk which, upon analysis, showed no more than a trace of fat. This is the cheapest separator yet made, and can be worked by a horse of any size, or by steam; indeed, we believe that the Aylesbury Company have worked it by hand-power. Like the larger machines of the same make, it will conduct the skim-milk and cream to a considerable height, which is not the case with

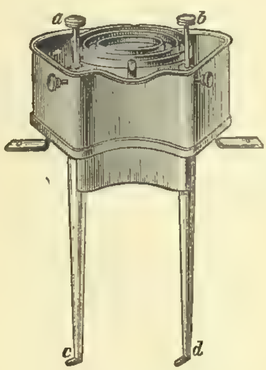

Fig. 43. Fjord's Regulator, for feeding the Danish Separator.

other machines, and which is a point of inestimable value, whereas its cost is only £27. The Danish Separator is, perhaps, the simplest made, and is, in many instances, worked by ordinary farm-labouring men and women.

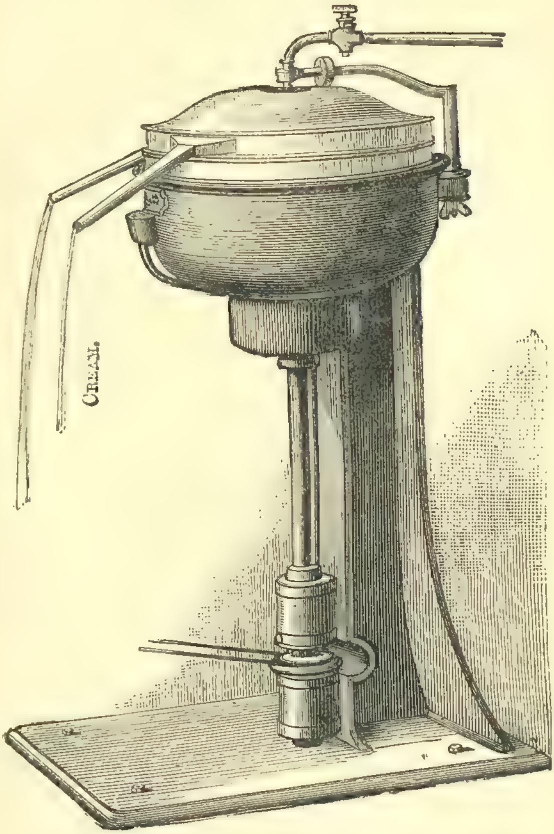

Fig. 44. The Swedish or Laval Cream Separator.

The *Laval*, which has been exhibited at the principal shows, and used in England for some few years, is a machine costing £37. The milk can be passed through it directly it is cooled, and can be worked continuously with either steam or horse power. It

revolves above 5000 times a minute, and separates 30 to 45 gallons an hour, leaving the milk perfectly sweet. The receiver of the machine is of steel, and supported by a vertical axis. It is filled

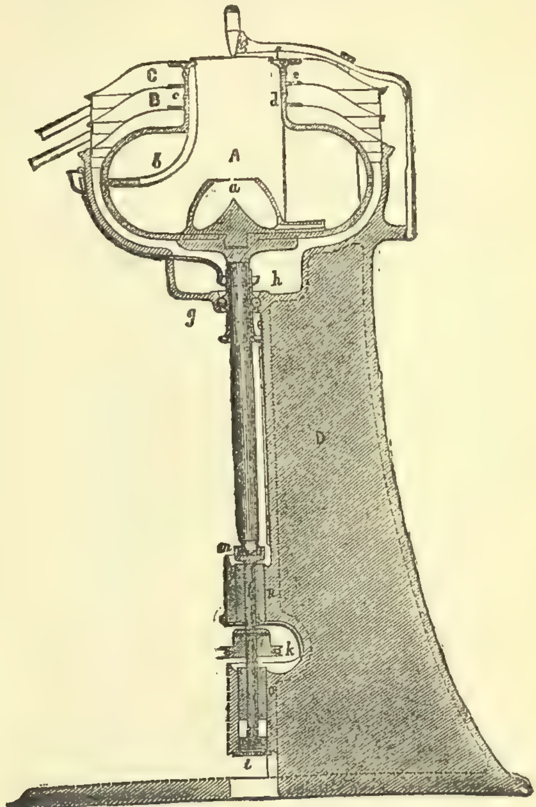

Fig. 45. Section of the Swedish Cream Separator.

with milk by means of a funnel, which passes into it through a central column. As the vessel containing the milk revolves rapidly, the lighter contents are gathered into the centre, and the heavier to the outside—the light cream, in fact, being separated from the heavier milk; and, as fresh milk enters, the skimmed milk is forced by it into a tube, whence, having by this means

reached a chamber, it escapes by a pipe. In a similar way the cream, as it is augmented by the process, is forced by the fresh milk into another tube, and, reaching another chamber, also escapes. The middle drum of the Laval is 11 inches in diameter; hence, revolving 5000 times a minute, the surface speed of the interior of the drum, required to separate the cream from the milk, is 15,000 feet per minute. At the Derby trial, 15 quarts of cream yielded 11 lbs. of butter, and this is considered a fair average. Among the advantages claimed for this machine are: Its simple construction; its facility for cleaning; it requires no ice; and it can be worked continuously with either steam or horse power. It is also claimed that it makes more skim and less buttermilk than the Danish.

There can be no doubt that the Laval has been one of the most successful of centrifugal machines, not because it does its work better, but because it was smaller and cheaper, and, consequently, more suitable to the requirements of the dairy farmer, who can neither afford the first cost nor the cost of working large machines, even when, as is seldom the case, they have sufficient milk to enable them to do so with advantage. Mr. Pilter, of Paris, who was working the Laval at a French Dairy Show in Normandy which we attended, told us that he had sold 200 machines in France, which very much astonished us; and since then great strides have been made. At the Reading trial, which we attended, when competing against the "German," it won the Gold Medal. The judges awarded the prize in accordance with the following points:

<table>
<tr><td>Power required in working ... ...</td><td rowspan="3">30</td></tr>
<tr><td>Quantity of milk per hour dealt with ... ...</td></tr>
<tr><td>Price ... ...</td></tr>
<tr><td>Lowness of speed ... ...</td><td>10</td></tr>
<tr><td>Completeness of separation (as per analysis) and general efficiency... ... ...</td><td>30</td></tr>
<tr><td>Simplicity of construction ... ...</td><td>15</td></tr>
<tr><td>Power of adjustment for varying percentage of separation</td><td>15</td></tr>
<tr><td></td><td>100</td></tr>
</table>

The two trials gave the following results :

ONE HOUR

Time Milk began to flow.	Time Cream began to flow.	Quantity of Milk passed through.	Quantity of Cream.	Quantity of Butter.	Quantity of Milk left in Machine at end of time.	Time occupied in clearing Machine.
		cwt. qrs. lbs.	qrs. lbs.	lbs.	lbs.	
3 min.	3 min.	4 3 10½	1 6	21	12¼	13 min.
TWO HOURS.						
2 min.	2 min.	8 2 18	2 5½	34¾	9 12¼	13 min.

The points obtained were the maximum number in all cases but price, for which 5 were given, and completeness of separation, for which 25 were awarded; or, in all, 90.

Thus in the first trial the 4¾ cwt. of milk (about 53 gallons), produced, after churning in the Excentric, 21 lbs. butter, or 1 lb. to about 2½ gallons of milk. The cream, 34 lbs.—not quite 14 quarts—certainly a very small quantity, thus gave about 1 lb. butter to $1^3/_5$ lbs.; not so good a result as at the Derby trial. The samples of milk taken during the trial, showed that near the beginning 0·29 per cent. of fat was left in, while near the end this was reduced to 0·20. On the second, or 2 hours' trial, the separated milk showed at three different periods 0·38, 0·21, and 0·35 per cent. of fat; which cannot be said to prove its having arrived at perfection.

The *Lefeldt* machine has been considerably improved, and is now more meritorious. We first saw it worked by the Anglo-Swiss Milk Company, at Zug, Switzerland, who speak highly of its powers. Lefeldt was one of the first to apply centrifugal force for the purpose of separating milk and cream; and although his machine, as it is now made, costs some £75 in the large size, skimming 150 gallons an hour, and £25 in the small machine, skimming 60 gallons, it runs at only 2400 a minute. The inside diameter of this machine is 24 inches, so that the inside circumference is 6·28 feet; thus, at the above-named velocity, the measure of speed required to separate the cream from the milk is 15·072 feet per minute, or 72 feet more

than the Laval. According to Fjord's experiments in comparing

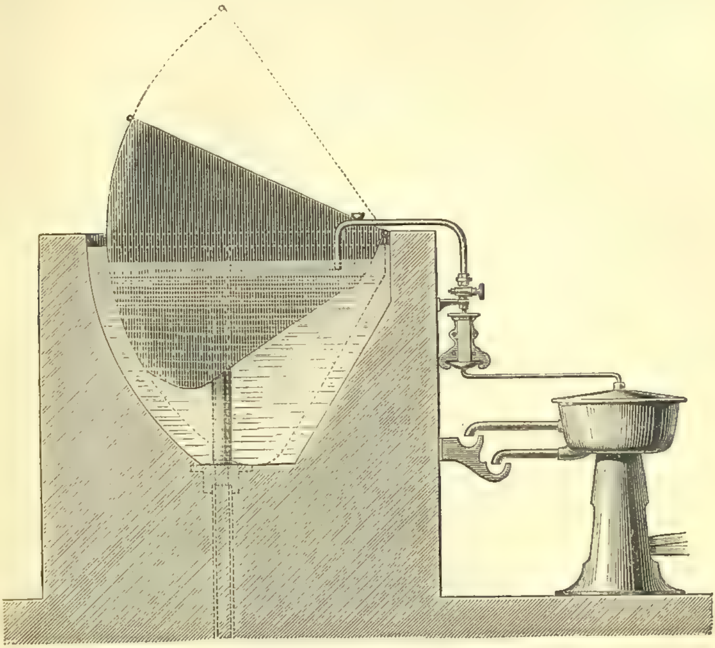

Fig. 46. Lefeldt's Cream Separator and Feeding Vat.
The Vat is shown tilted, and is surrounded with hot or cold water at discretion.

the Lefeldt with the ice and the pan systems of setting milk, against 100 regularly yielded by the machine, these gave as follows :—

	Ice. 34 hours.	Pans. 34 hours.
October to December ...	92·4	87·3
Farm milk — February ...	88·8	88·5
,, March ...	93·2	95·0
Bought milk—February ...	84·9	83·9
,, March ...	88·2	92·2
July	95·7	87·9
August	103·2	90·1
September	96·4	86·2

The Professor from his 1880 experiments compiled a table showing that the Lefeldt gave percentages of butter above the ice method varying from 3·7 in March to 28·0 in November, and from 5·4 in February to 16·0 in September by the pan system. In the next year the Lefeldt, originally working at 950, was altered, and its speed reached 2000, while the drum held 140 lbs. When competing against the Danish machine it left 0·37 per cent. of fat in the skim-milk, and received 91 points against 100 for its working, and 98·3 against 100 for skimming its last contents.

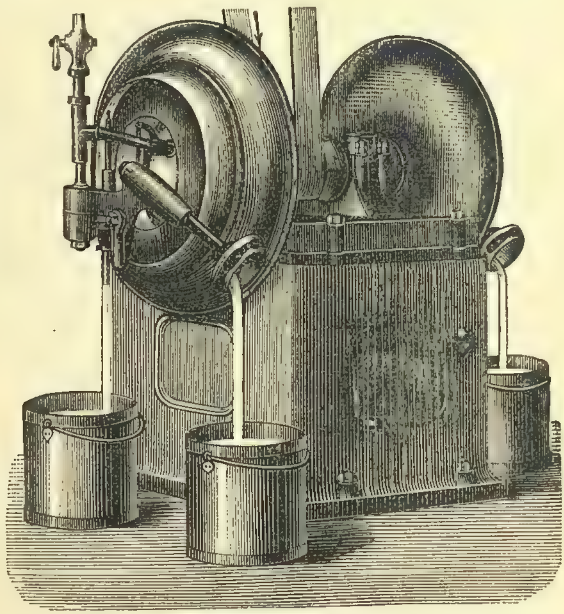

Fig. 47. The Petersen or German Separator.

Another recent invention in this department is the *Petersen*, which was worked for the first time in England at the Royal Show at Reading, at which trial we were present. It is a magnificent machine, but failed to beat the Laval, against which it competed for the Gold Medal, as the skim-milk contained too large

a percentage of fat. It will be seen from the following that it is highly esteemed where it is in use, and that it is really as good as it is ingenious.

At the works of Nicola, at Delft, in Holland, two creamers are worked, the Lefeldt and the Petersen; the latter, since May, 1881. The manager speaks highly of this, on account of the little driving power required, and says that, working steadily every day at 800 revolutions a minute, barely ⅔ of its nominal speed, it skims 20½ litres of cream from 492 litres of milk per hour; these quantities being largely increased at a higher speed. The skim-milk contains 0·4 per cent. of fat only, according to analysis; and the buttermilk is stated to be so small as not to be worth mentioning. With regard to this statement something may be said, for every practical reader will at once recognise the small percentage of cream, about 4 per cent. Many cows give from 6 to 7 per cent. of butter-fat; and even Dutch cows in some instances exceed 5 per cent. Either the milk separated was uncommonly poor, or else the cream skimmed was wonderfully condensed and free from buttermilk; for upon no other hypothesis can it appear consistent to take 4 per cent. of cream from new milk, and yet leave but 0·4 of fat behind. On the Farming Society's estate at Barmstedt, the machine works at 1100, and skims 400 litres per hour. Herr Peters, of the Royal Council of Economy, says that the butter from cream separated by the Petersen is much fancied in Berlin, and that the cream remaining in the blue milk is hardly worth mentioning. With regard to the result in the Centrifugal Farming Establishment, at Hamm, near Hamburg, where the machine works daily at 1100 revolutions, it skims 400 litres and leaves but ½ per cent. of fat. It is stated that more could be taken, but that the Hamburg buyers of skim-milk might refuse it; while, if fat "of a lower degree" were introduced into the butter, it would lose quality. This, it seems to us, is a matter of theory which we need not discuss.

The illustration shows a double or two-drummed machine.

The two wheel-like drums are firmly nutted on to each end of the axle, in the centre of which is a pulley wheel, and which is driven by the band shown. The new milk is introduced into the drum as follows: It is poured from the tap, shown above, into the funnel, whence it flows into the tube, and thence into the inner ring or drum, which is fastened to the inner nave wall. From this it is thrown by two tube supporters towards the interior of the large drum. Here the cream is separated from the skim-milk by

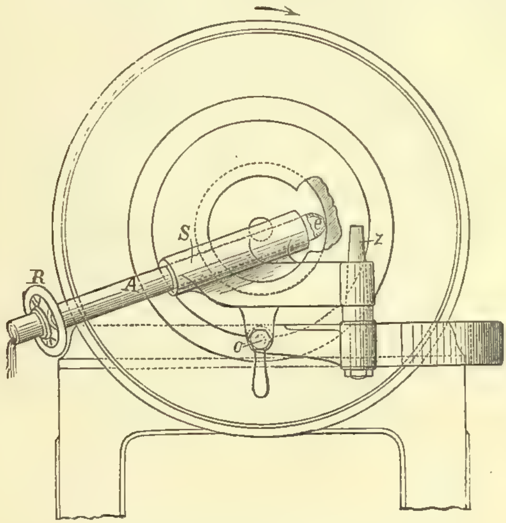

Fig. 48. Front view of the Drum of the German Separator, showing the action of the Cutting Tube upon the Cream.

centrifugal force, and the inner ring (shown in the engraving) is the milk, on the exposed surface of which is the cream. When the separation has commenced—and it does not commence until some little time after the machine has started—not, in fact, until the volume of milk is sufficient to bring its inner surface on a level with the skimmer—this skimmer, or cream-cutter, which is fixed to a pivot underneath the funnel, is swung round into position, when its spoon-like end takes off the cream, which at once runs away in flakes into the right-hand pail, shown in the engraving.

The skim-milk, which is of course whirled round inside the drum, is carried through another tube into a hollow rim, which is fitted on the face of the drum. There it is again whirled round, spreading a second time into a centrifugal gathering, when it is skimmed by a small skimmer, and driven out. This smaller skimmer also revolves around the pivot, and can be adjusted to the revolving milk as desired. The continual current of new milk

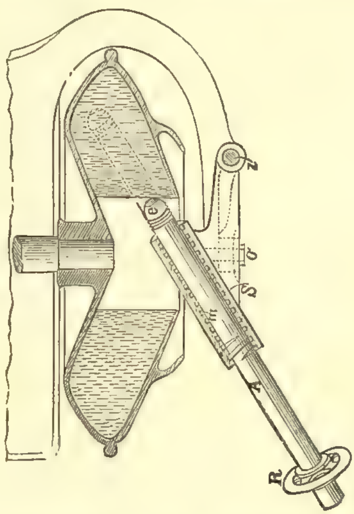

Fig. 49. Section of the German Drum, showing the Tube while skimming off the Cream.

causes proportionate quantities of skim-milk and cream to be taken out of the drum; and, when the new milk is nearly exhausted, the operation of setting the machine off work must be commenced. To effect this, the funnel must be first fed with skimmed milk, thus forcing the remaining cream in the drum out over the spoon. Next the filling is stopped, and the cutter ceases to work. The filling tube attached to the funnel is swung round, and the cover, or door, also attached to the pivot, is swung into its place, covering the central opening of the drum. This cover, which has an axis of its own, is at once carried round by the drum,

when the machine should be gradually stopped. In a few moments the milk will lose its revolving power; it will then suck back the skimmed milk contained in the outer ring, and the whole will fall in with a soft splash. When the machine has stopped, the whole can be drawn off through a hole in the partition, which had been previously plugged.

This machine is made in different sizes, and with one or two drums. In the small size, each drum holds 10 gallons, while in the large it holds 20 gallons. The respective sizes will skim 75 and 100 gallons per hour per drum. The space required for the machines is, for single-drum machine, 3 feet 9 inches, and 4 feet; with double-drum, 4 feet 10 inches, and 5 feet 4 inches, respectively, for each size across the machines; while the length is 3 feet and 3 feet 8 inches. The single-drum machines require 1 and 1¼ horse power, the double, 1¼ and 1½; so that a 200-gallon machine is worked at 50 per cent. more power than a 75-gallon.

We have also had the opportunity of examining a machine made by Fesca, of Berlin, which we saw working in Brunswick. The *Fesca* separates 300 litres per hour, and is somewhat elaborate in construction. It gives 40 litres of cream per 300 litres of milk (17 litres of milk making 1 lb. of butter); while the Laval gave 1 lb. in about 25 lbs. of milk.

This centrifuge is claimed to skim milk in the most perfect manner, leaving not more than 0·15 to 0·25 per cent. of fat; to obtain cream free from gas and in the least possible degree impoverished by milk, and consequently only to contain about 12 to 14 per cent. of the worked milk; to perfectly remove the excrements contained in the milk; to permit of the easy cleansing of the drum and all other parts of the machine touched by the milk; and to work with a minimum working power. To prevent the possibility of explosion, the drum is of small diameter, *i.e.*, 11 to 16½ inches, according to the pattern of the machine, while the speed varies between 2060 and 2525 rotations per

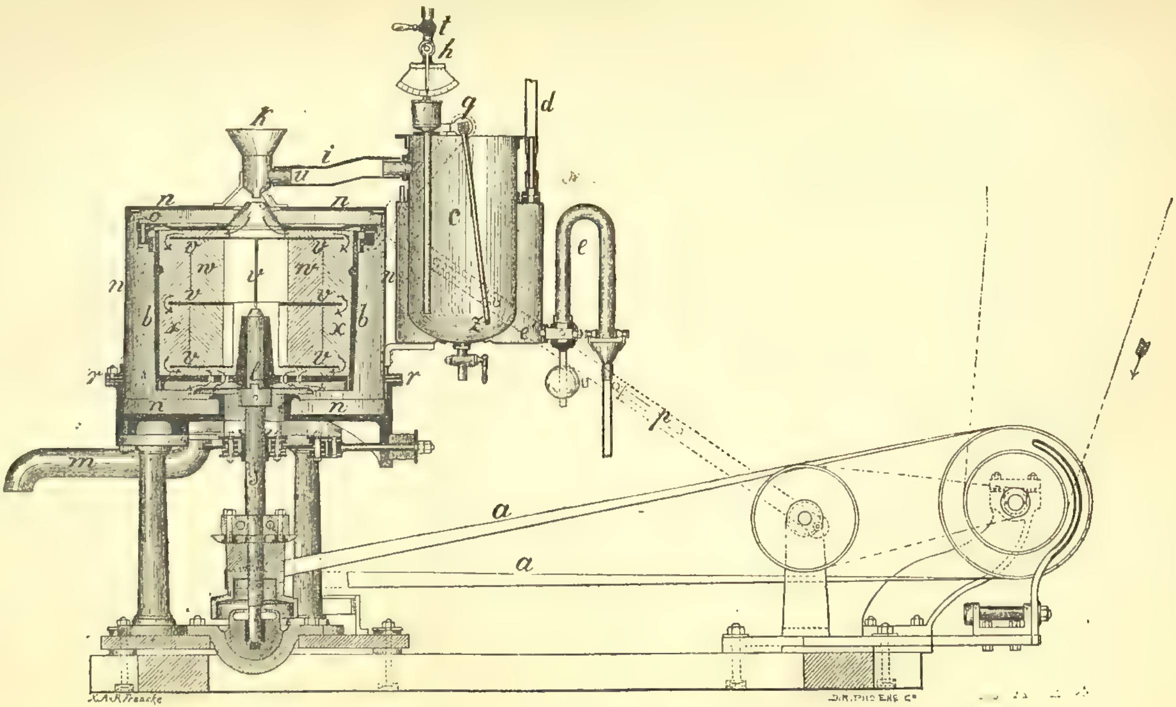

Fig. 50. The Fesca Cream Separator.

minute. With regard to the necessity for the milk having a temperature of from 76° to 80° Fahrenheit, in order to obtain a successful result, it is not a mere matter of theory, but it has been proved by experience that the separation of the blue milk from the cream by centrifugal force is consequent upon the difference in their specific gravity. This difference is almost imperceptibly small at a lower temperature in the full milk, but increases materially when it is warmed. In case the milk comes direct from the cow to the machine, artificial warming is not necessary, as it is when it has to be transported a long distance, when it should be first thoroughly cooled. On account of the easy decomposition of milk it is not advisable to keep it long at the above temperature, therefore large quantities should never be warmed for the separator. For this reason Messrs. Fesca constructed a warmer in connection with their machine, through which the cold milk flows on its way to be separated. This apparatus warms the milk partly by means of steam and partly by the walls being heated with hot water, and it is provided with a warmth regulator. This regulator reduces the quantity of heat which can be conducted through the warmer as may be required, so that, for example, by its means one milk of 43° Fahrenheit can be raised to 64°, and one of 60° reduced to 46°.

The *Fesca* centrifuge is made in three sizes and provided with an elastic movable bed for the drum axle. It is driven from below, and its drum moves in the upper part of the frame. The steam enters the hollow walls of the milk warmer, which is provided with a tube and mouthpiece. There is a warmth regulator, movable at the hollow tap (*é*), which serves at the same time to conduct away the water condensed from the steam, and to regulate the heat of the inflowing milk. The new milk to be worked is contained in a high standing vat, and runs through the tube (*g*) into the warmer. A cock with hand and scale at the end of this tube serves to regulate the quantity of new milk flowing in per minute. This cock (*h*) remains standing in the

place shown by the scale to ascertain a stated quantity of inflowing milk, while the shutting-off tap (*t*) connected with it must be either quite open or quite shut, just as the milk is to flow in or not. The cold full milk running from the vat in the warmer, passes through the tube (*i*), and the cup (*k*) into the centrifuge. If, however, it is already warm from the cow, it is conducted immediately into the drum by the tube (*g*) and the taps (*t* and *h*). In this case the tube (*i*) is to be removed, and the opening in the cup (*k*) is stopped up. The cream separated from the full milk collects in the drum, whereas the skim-milk continually runs away through the tube (*m*) and the collector (*n*), and in the same measure as the full milk enters at (*t*). As soon as a quantity of cream has collected in the drum, which occurs after about an hour's working, the inflow of milk is stopped by shutting off the tap (*t*), otherwise it would pass out with the skim-milk. At the same time the supply of steam at (*d*) is cut off, and the centrifuge is brought to a stop. The cream then runs away through the collector (*n*) and its tube (*m*). Under the mouth of this tube a movable receptacle can be fastened with props, which, by changing its position, will carry away the two fluids in two different ways. The one position directs the continual flow of skim-milk into a channel, and thence to a cooling apparatus, while the other is intended to convey the cream into a tube placed beneath. Immediately the cream has run out of the drum the centrifuge is brought into full work again, and a second separation commenced. In this and every following warming the ten litres of skim-milk which have been thrown off should be poured back into the vat, as it contains a little cream, which by this means is recovered. Cream also adheres to the floor of the collector (*n*), but by running through the skim-milk it is washed off and carried away with it. After the washing is ended and the milk consumed, the drum is opened in order to rinse out the remaining cream with a little milk. This rinsing must be done carefully, so that the excrements of the milk which have

been collected may not be washed out with the cream. If any warmed milk remains in the warmer it is worked as follows: After shutting off the steam supply at (*d*), it is drawn off by the tap at the bottom and slowly poured into the drum through (*k*). When this has been done the centrifuge is brought to a standstill for the purpose of letting the cream off, and then the washing

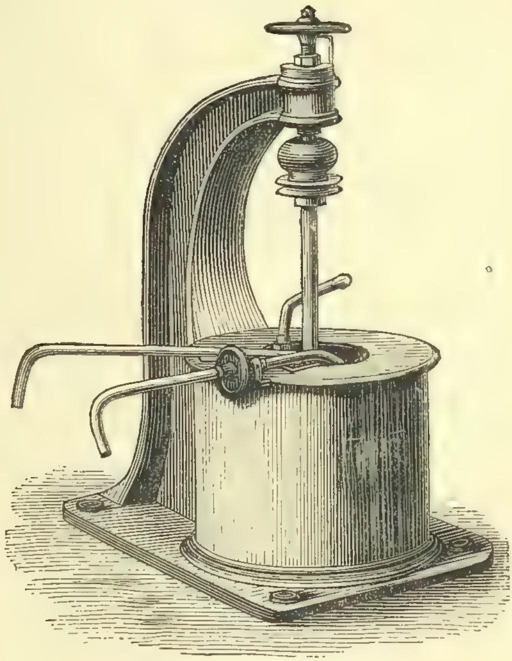

Fig. 51. The Nakskov Separator.

out of the cream and cleansing of the drum commence. An essential part of the drum which causes the continual outflow of the skim-milk and the retention of the cream is a peculiar and simple depositor (*v*) made of tin. This forces the milk flowing in at (*k*) to pass through the shaft of the drum in the required manner, whereby the full milk under the influence of the centrifugal force divides into two parts, the lighter, cream (*w*), and the heavier, skim-milk (*x*). The former is held back through the

horizontal walls of the depositor, which reach nearly to the extent of the drum, leaving free only narrow-shaped crevices, while the skim-milk, according to the position of the shaft, forces itself through the crevices, and disappears through the holes in the floor.

The *Nakskov* separator is manufactured by Tuxen & Hammerich, of Denmark, and is the only one of the new machines exhibited in the Danish separator competition which has, so far as we can learn, been placed upon the market. Its cost in Denmark is £28, with the addition of £3 for intermediate motion. The makers claim to skim with this machine, by means of one horse, 35 to 40 gallons of milk per hour, and to leave no more than 0·14 per cent. of fat in the skim-milk. It is stated that the cream can be regulated in thickness as in the Danish machine, and that the last contents of the drum are skimmed by the addition of separated milk.

The machine, which is in many respects an imitation of the Danish, is provided with a cast-steel drum and protected by an iron rail. We have received a testimonial from one of the purchasers of the Nakskov—Mr. C. Renner, of Christiansdad—who states that he keeps 100 cows, and creams and churns at the same time without the horse getting warm or overworked. By means of this machine he says he has reduced the quantity of milk required to make 1 lb. of butter by 6 lbs. to 8 lbs.; and he finds that the cream is not whipped into froth. We are unable to give any personal opinion, inasmuch as in the Danish competition the machine did not work properly and was stopped; whereas at the Health Exhibition in London in 1884, where it was exhibited by an English firm, it was not worked upon either of our visits, and as we have been unable to obtain any particulars of its working in England, it may be presumed that it has not been considered satisfactory.

There is no doubt that the composition of the milk has a great deal to do with the action and results of centrifugal

machines. If it be true that the globules in milk vary in size—and beyond the fact that the microscope shows what we take to be globules, there is no proof of their existence—as well as consistence, according to the breed and feeding of the cow, and that the smaller and stiffer-coated ones are left in the milk, then there is every reason to believe that cream separation is yet in its infancy. So far we know, that the fat shown by analysis to exist in a given sample is never obtained by the churn, and that of two samples, churning will obtain more per cent. from the one than the other, which may be supposed to contain more small or tough globules. These remarks may suggest to some skilful reader the desirability of perfecting a machine which, although new, is of considerable value, and which, if still smaller, cheaper, or adapted to manual power, would revolutionise the dairy system. Even now the centrifugal machine separates the dirt from the milk, and, among other advantages:

It enables the dairyman to churn the morning of milking.

To sell skim-milk absolutely sweet.

To abolish dairy-room, setting-pans, etc.

It provides the sweetest of cream, which will keep longer; also sweet buttermilk.

It furnishes a more complete separation of the cream.

All the products are sweeter and purer.

It may be noted, however, that while separated milk makes a poorer cheese, the cream yields more butter if it is allowed to stand some time before churning.

Creamers.

The system of setting milk in deep vessels, or tanks, is gradually gaining ground, and there are numbers of large and intelligent producers, who have hitherto used the old shallow pans, but who, convinced of the superiority of the new system, have at once adopted it. It is a fallacy to suppose that cream rises quicker in a shallow vessel, than in a deep one. The deep-

setting system has been applied by two or three inventors, and although their utensils are sometimes expensive, there can be no doubt of their value to a dairy-farmer, especially if his dairy is a large one. In the *Cooley* process, deep round cans are submerged in a tank of cold water. The cans are covered with a loose lid, and as the water flows over it, air is entirely excluded. The adapter, William Cooley, of Washington, Vermont, claims that if the water is kept at about 50° in the warm season of the year, and 5° less in winter, the cream will rise in 12 hours. If any difficulty is experienced in hot weather, a portion of the water should be run off, and a supply of colder added, and this may be done 2 or 3 times over, as may be found necessary. The fact that the air is excluded, is a great advantage, more especially if the milk has been aërated before setting, as it should be, and as a consequence, impurities in the air and atmospheric disturbances have little or no effect upon the milk. The *Cooley* cans are 20 inches in depth, by 8½ inches in diameter, and hold 16 quarts each. The lids are fastened very easily, and the air which finds its way under the rims before submerging, prevents the ingress of water. The tanks or coolers, are lined with metal, and fitted with pipes for the use of running water, where such can be obtained. It is claimed that deep-setting removes all taint from the milk, and enables the butter-maker to make sweet butter from sweet cream, retaining all the richest flavours of the milk. Professor Arnold doubts whether as much or as good butter can be made by the *Cooley* process from sweet as from sour cream. He states, that both quantity and quality depend more upon the ripeness of the cream, than the fact of it being sweet or sour. In the *Cooley* process, the milk being submerged, the cream gets but little airing, and the temperature is too low to allow of much change in the short time required to get the cream all up and ready to skim. Milk which has been submerged at 40° Fahrenheit, and is then raised to 60° Fahrenheit—a temperature favourable for ripening—will seldom acquire

a suitable maturity for churning, in the short time it will remain sweet, as it will sour very soon, although it is better to let it do so than to churn, while sweet, but too new. The *Cooley* process, therefore, is not a favourable one for making sweet-cream butter, and it would hardly be advisable for the average butter-maker to undertake it. To make sweet-cream butter successfully, the milk should be set in open vessels, and pretty well spread in pure air, at about 60° Fahrenheit. If the milk is sound, as it should be, the cream will then be so exposed to the air, as to be ripened sufficiently for churning, in from 36 to 48 hours, and still be sweet; it will make butter of the finest quality, and as much of it as though it had been kept till it was sour. This course, it is plain, will require more room and more labour than deep and cold setting, and also more skill and attention.

At all events, whether the Professor is right or wrong, the *Cooley* system, although less valuable than the *Swartz*, from which it was copied, is largely adopted. That the close contact between the water and the milk is advantageous is clear, for, presuming the milk to be 80° to 90° when it is placed in the tank, and the water at 45°, the natural consequence is that the impure gases escape from the milk into the water, which they are enabled to do as the lids do not fit close, but when submerged are raised half-an-inch, thus permitting perfect circulation.

In dealing with cream raised by the Cooley *Creamer*, the secret—if secret it be—is to so manage that, before churning, the cream has arrived at a similarly ripe condition as when raised by the old system. Cream raised by deep setting is thinner, and heavier, and in larger quantity, but it will be admitted that it is much more consistent than that raised in shallow pans. One of the chief causes why deep setting is not still more general is the cost of the utensils, and, although it may be improved in this particular, it cannot be expected that a very great reduction will ever be made. A large quantity of milk can by this system be set in a very small space indeed; a moderate-sized refrigerator,

costing, with the cases, some ten guineas, will hold the milk of 15 cows, which would occupy a very large space in open pans in

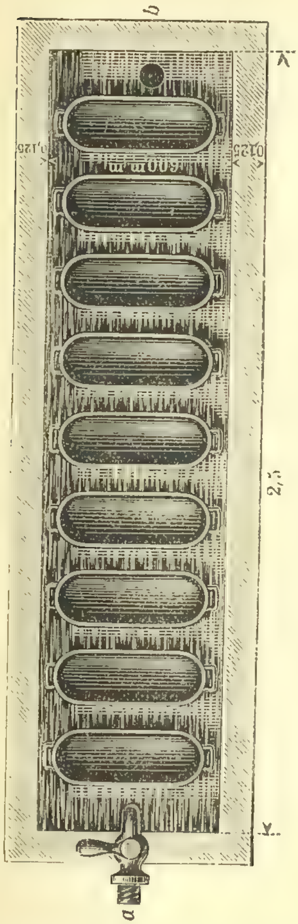

Fig. 52. Swartz Vat, with Cans seen from the top.

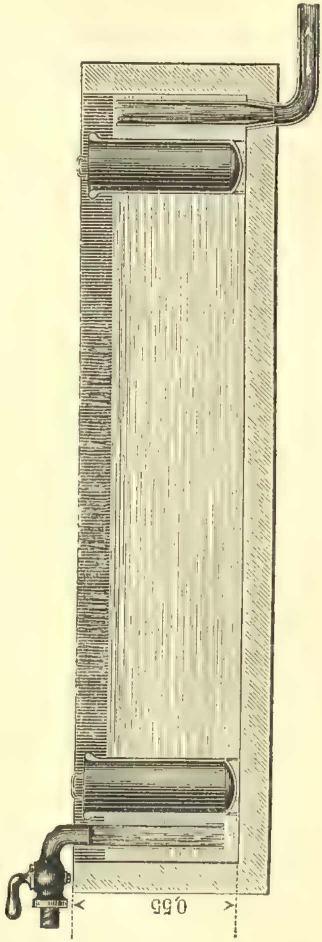

Fig. 53. Section of the Swartz Vat, showing the Cans.

a good-sized dairy, so that if we consider the cost of building a dairy itself a great saving would be effected.

The *Swartz* system, which has long been known in Northern Europe, is also a deep-setting system, but the cans are oval

instead of round. It is an older system than *Cooley's*, but not quite so elaborate, and the inventor who gave it his name is a Swede. In this system the tanks are made of stone, slate, iron, cement, or brick, and are 2 feet deep—the depth of the cans—by a yard wide, the length varying according to the size of the dairy. A tap is provided for the supply of cold water, and at the other end is an overflow pipe. The cans, filled with milk to within 2 inches of the top, are placed in iced water, at 38° Fahrenheit, which rises to the height of the milk and rapidly reduces it to very nearly the same temperature. Contact with the air is not a matter of great consideration, as in the *Cooley*; but lids are provided if it is desired to exclude it. The chief bar to popularity in the *Swartz* in England, is the permanent necessity for ice, and thus it has to give way to other systems.

We have seen this system in practice in Denmark, where it is quite general, and much preferred to the *Cooley*, although the winters are as slight as in this country. Ice, however, is preserved, just as it ought to be with us, and in a most inexpensive manner, sometimes keeping until a second summer. It would appear that as a maximum quantity, 10 lbs. of ice are necessary for every gallon, when a body of milk has to be cooled to 41° Fahrenheit; thus, supposing a farmer with 40 cows is receiving 80 gallons per day he would require 800 lbs. of ice, or during the four summer months 48 tons, which could be stored with consummate ease in a most primitive and inexpensive ice-house.

In order to test the value of the *Swartz* system some experiments were made a few years ago by M. Dahl, who found that, with milk which had been maintained for 36 hours at a temperature of 38° to 40° Fahrenheit, 5 gallons 2 quarts 1 pint were required to obtain 1 kilogramme of butter (nearly 2¼ lbs.). He also found that, with some of the same milk—and large quantities were tested in each case—it required 6 gallons and 1 pint to obtain a similar quantity of butter when the temperature was raised to 64° Fahrenheit. M. Tisserand, the well-known French

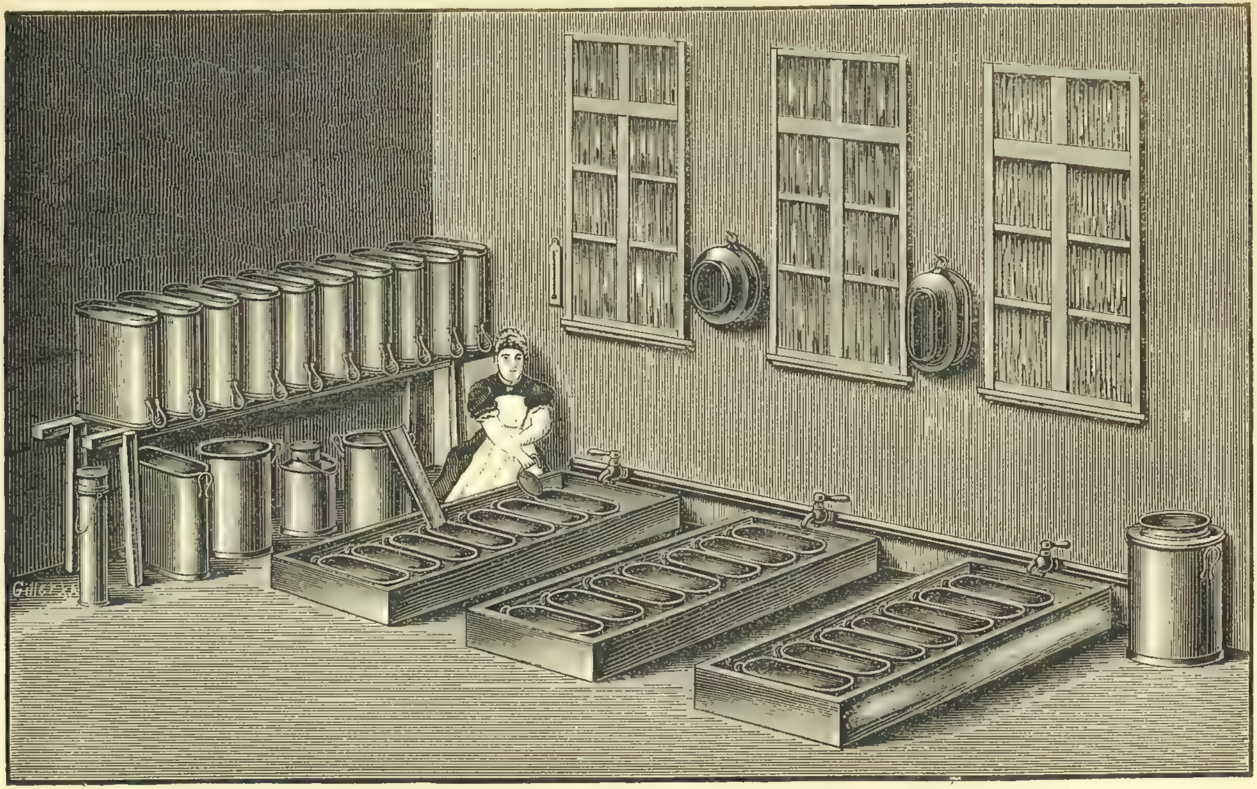

Fig 54. A German Milk-Room on the Swartz System.

agricultural authority, in his experiments found that milk set at 35° to 36° Fahrenheit yielded the whole of the cream at the end of 12 hours; that when it was set at 42° Fahrenheit it took 24 hours to accomplish the same result; and that at 58° to 60° Fahrenheit the whole of the cream was not obtained under 36 hours. Again, to make one kilogramme of butter, he found that the following quantities of milk were necessary when the samples were set at the temperatures specified opposite to them, the milk being set for 36 hours:

18 to 19 quarts	35° Fahrenheit.
20 ,, 21 ,, ...	39 ,,
22 ,, 23 ,, ...	48 ,,
23½ ,, 24½ ,, ...	52 ,,
24½ ,, 28 ,, ...	57 ,,
30 ,, 31½ ,, ...	72 ,,

M. Schatzmann, whom we had the pleasure of meeting at the Station Laitière, at Lausanne, of which he is director, found in his experiments, that from milk cooled in vessels of water at a temperature of 39° to 41° Fahrenheit, one kilogramme of butter was obtained from 20½ quarts of milk, whereas 23½ quarts were required when the milk was placed in wooden vessels and allowed to remain at the ordinary temperature. Finally, Pouriau quotes the experience of M. Le Sueur, a landowner in Calvados, who states that milk stood at 39° Fahrenheit gave one kilogramme of butter to each 20½ to 21½ quarts of milk, that at 54° Fahrenheit 23½ to 24½ quarts were required, and that at 66° Fahrenheit 27 to 29 were necessary.

In his remarks upon the *Swartz* system, Pouriau gives the following as its advantages:

1. The rising of the cream is very rapid.

2. The yield of butter is larger.

3. The butter, once salted, can be preserved for a longer period.

4. The skim-milk is sweet.

5. The system maintains an exceptional economy in time, in space, in material, and in labour.

The Aylesbury Dairy Company have introduced a cream-raising can which they call the *Aylesbury*, and which is really a variation of the *Cooley*. In this can, which is entirely submerged, there is a constant cold stream passing through the milk by means of a column in the centre, and it does not in any way interfere with the skimming of the milk, as the cream may be taken off with a conical skimmer, or left in the can, when the skim-milk has been drawn from beneath it. The *Aylesbury* is a very good system, and certainly not costly.

Richmond's (Fig. 55) system is a comparatively new idea. A rectangular metal tray is used, this being fixed in an outer shell which is filled with cold water. In the centre is a plug, which when drawn, permits the skim-milk to escape, leaving the cream behind. Two trays are placed over the milk, these being filled with cold water in hot weather, so that the whole body is surrounded by it. There is an ice-box at one end, in which contact takes place between the water and the ice, and a patent arrangement for conducting the water into the cooler. This cream-raiser is made in sizes to hold from 30 to 60 quarts.

The *Hardin* system is unknown in this country, but is nevertheless ingenious. It is based upon the principle that air is cooled quicker than water, and the milk is placed in a cupboard or chamber which is cooled by ice. It is quite simple, and may be readily adopted by any one with ice at command.

M. Fouchier, of Langeais, Indre-et-Loire, a well-known inventor and manufacturer of dairy utensils, makes an apparatus which he calls the *Écrémeuse à siphon*. It is claimed that by its use, (1) a larger quantity of cream is obtained; (2) the cream ascends more rapidly and equally in all seasons of the year; (3) the cream is very sweet, an essential point where butter is to be preserved; and (4) the skim-milk remains perfectly sweet, and therefore of the most use to the farmer or dairyman. The *Écrémeuse* is composed of a tinned iron vase, which contains the milk; a wooden receptacle lined with zinc, in which the water is

placed for cooling it; and a siphon, by means of which the skim-milk is automatically and completely separated—one of the most happy innovations in connection with the manufacture of dairy

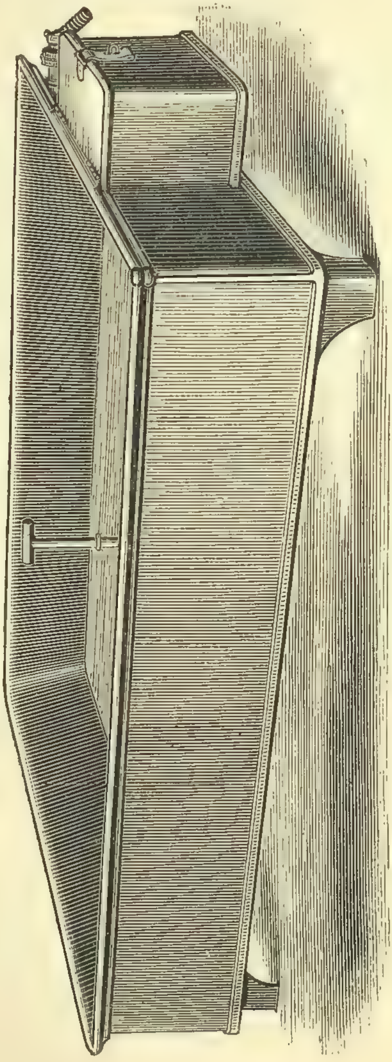

Fig. 55. Richmond's Creamer.

utensils. When the cream has risen—in about 24 hours—and before the milk has curdled, the siphon is fixed in position, care being taken to set aside a little of the cream so that the tube of the siphon which is inserted in the milk may not become choked. By means of this, and of another tube with which the siphon is provided, the skim-milk can be quickly drawn off, leaving the cream upon the bottom of the vase, where it is easily gathered up with the spatula provided for the purpose.

Ahlborn's *Creamer* is an elaboration of the *Holstein* system of Destinon. *A* is the milk-vat; *B* is the outer cooling-pan; *C* is the

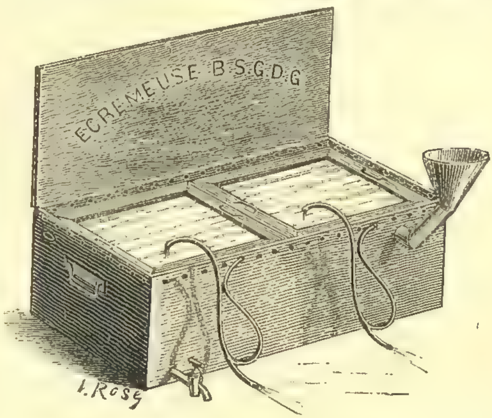

Fig. 56. Fouchier's Écrémeuse.

cream-skimmer adjustable by the screw *L*, sliding on rollers; *D* is a brass tube fixed in the milk-vat; *E* is another tube sliding through *D*, and is set up or down by means of the lever *J* and the screw *K*; *a* is an indiarubber ring; *G* is a standpipe fitted with a cone, which closes *E* while creaming; *H* is a water standpipe perforated at the top and fitted with a cone, which allows the warmer water, on its rising, to flow out of the cooling-pan at a certain height.

Among the best-known systems of raising cream is that named after Destinon, a Holstein landowner. The apparatus consists of a

rectangular shallow vat, varying in size according to the requirements of the dairy. The largest vats, however, hold 15 gallons, and are 23½ inches in width by 6 feet 10 inches in length. The vats

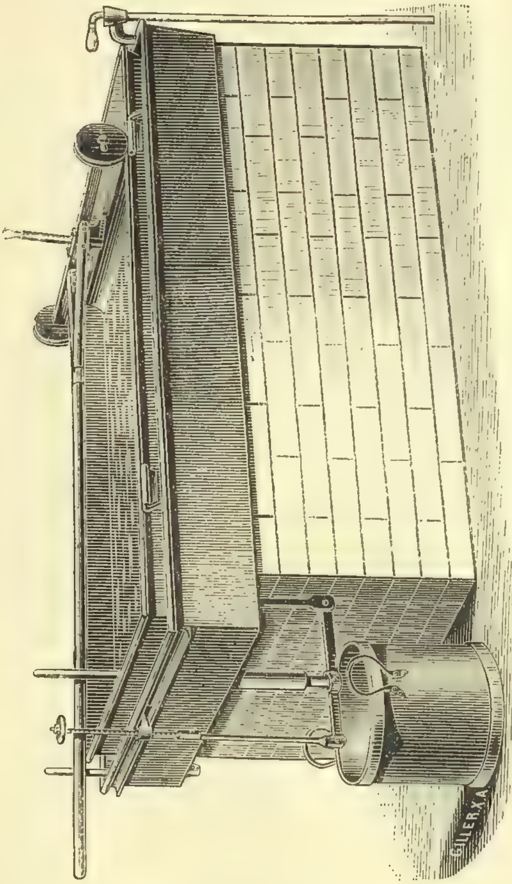

Fig. 57. Ahlborn's Improved Creamer.

are placed in the dairy, side by side upon a brick stand, and, when the cream has risen, it is drawn off by an instrument the two ends of which are fixed to wheels running along the edges of the vat. This instrument sweeps, as it were, the cream from the

surface of the milk into a receptacle placed at its mouth to catch it, and which must be a little wider than the vat itself. The disadvantages of the apparatus are that it is very high in price,

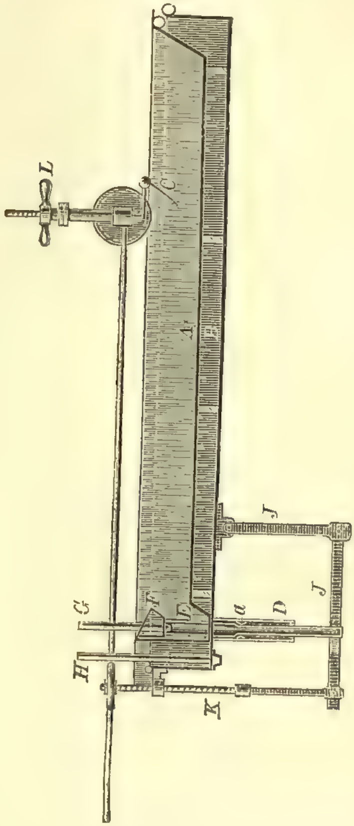

Fig. 58. Side View of Ahlborn's Creamer.

requires a large space, and cannot be used except in large dairies, where quantities of milk are daily creamed.

Another artificial creaming apparatus, known in France as the *Reimers*, is made to hold as much as 154 gallons, and costs £8. Here, two rectangular shallow vats are used, the one standing within the other, but leaving a free space both below and at the

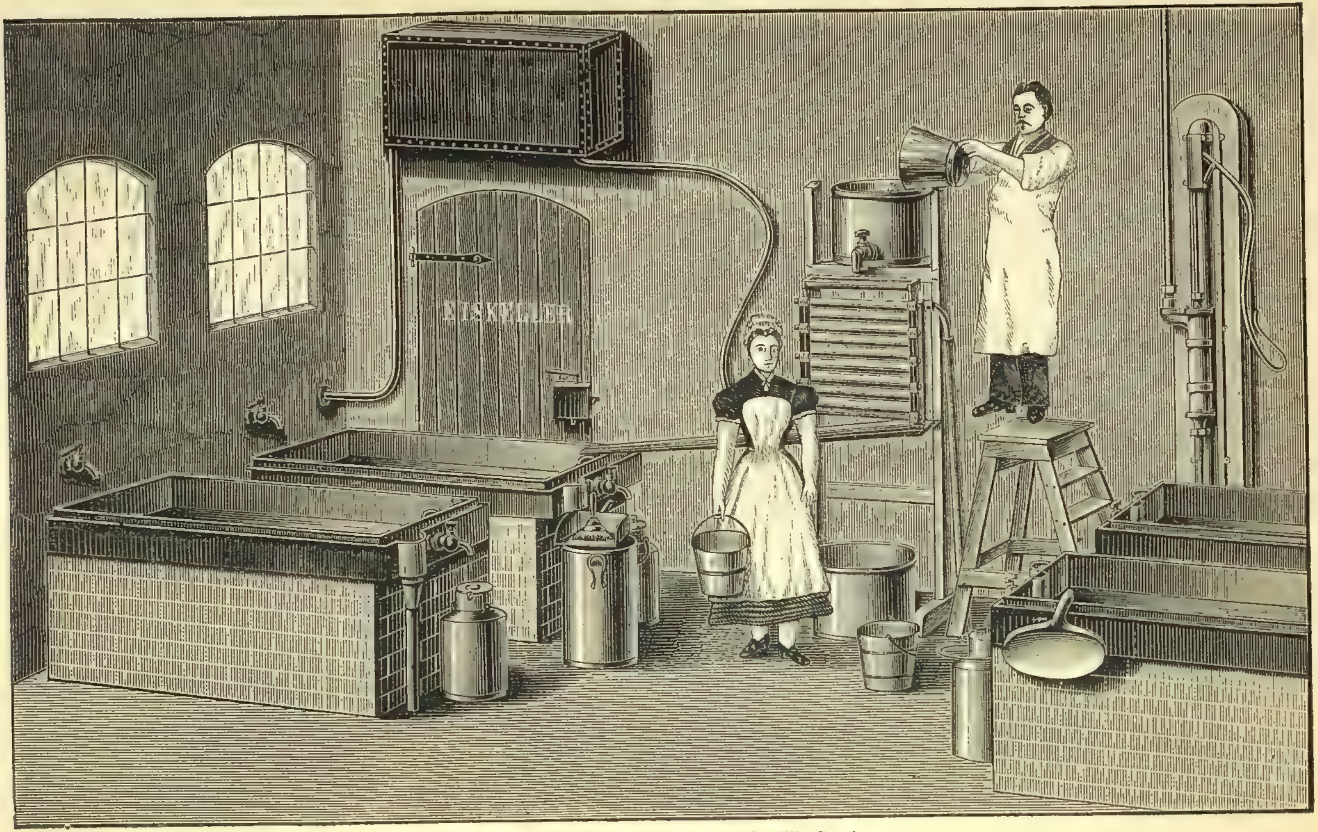

Fig. 59. The Reimers System of Milk-Setting.

sides for cold water, which is placed round the inner vat in order to cool the milk; indeed, if necessary, it can be used similarly

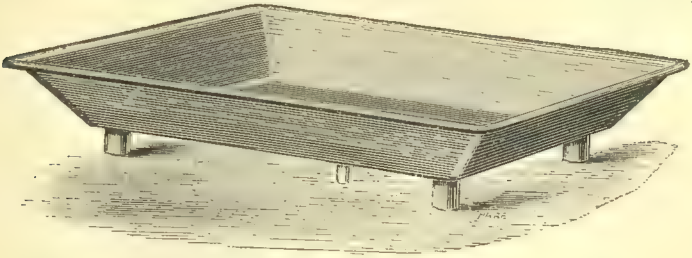

Fig. 60. Rectangular Milk-setting Pan.

for hot water. In creaming, the cream is not skimmed off, but the milk is drawn from beneath and the cream left behind. The

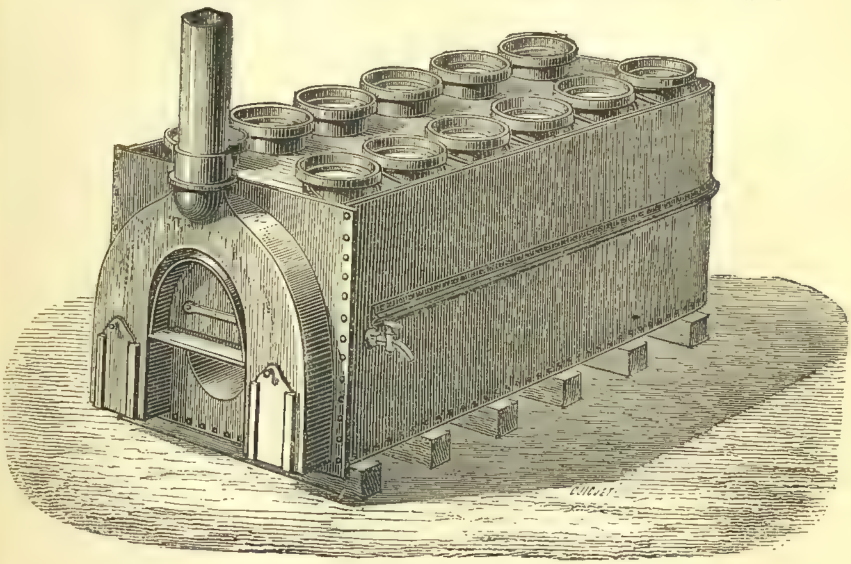

Fig. 61. Milk-Heating Apparatus.

idea is a good one, but it is not carried out in a sufficiently practical manner to become popular among the dairy-farming public.

The *Shallow-setting*, or old system, is well known to every

one. In some districts large, flat, leaden vessels are used still; but they are costly, cumbrous, and antiquated. In others, metal

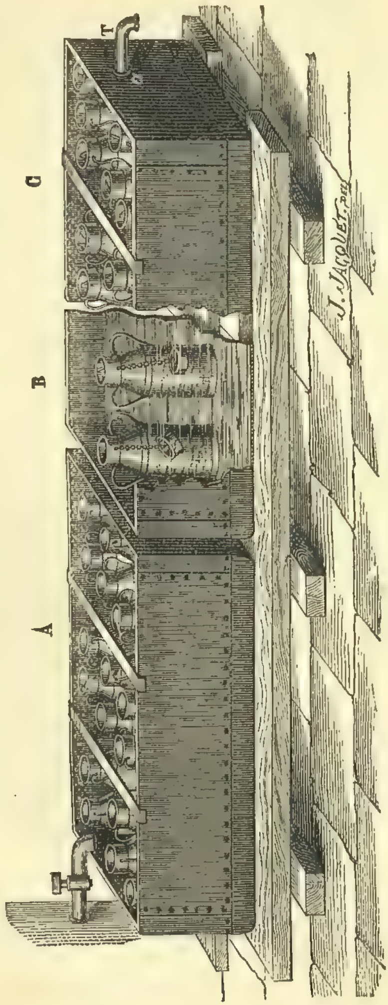

Fig. 62. Milk-Cooling Tank.

pans, which rest upon trestles, are the fashion. These are certainly more useful, but only of value in a large dairy, as they will hold

15 to 20 gallons. Their depth is generally 6 inches, and they vary from 40 to 50 inches in length, by 24 to 28 inches in breadth. The well-known circular and oval pans, with sloping sides, are perhaps used more than all other vessels put together. They can be obtained in block-tin, china, glass, and glazed earthenware—all of which are clean and non-absorbent.

Milk Heating and Cooling Apparatus.—The vessels shown in Figs. 61 and 62 are such as are adopted in Paris by some of the principal wholesale milk-dealers for cooling and heating the milk. They need no description, inasmuch as they explain themselves.

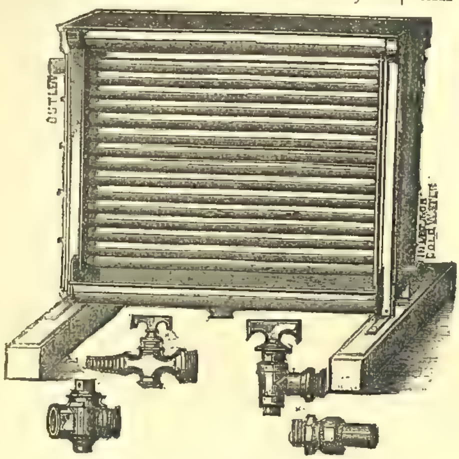

Fig. 63. Bott's Capillary Milk-cooler.

The best known *Milk-cooler*, or refrigerator, is undoubtedly Lawrence's *Capillary.* By its aid the milk-seller can cool the milk immediately it is drawn, and so enable it to keep longer than it would do if transported in its warm state; for, the more rapidly it is cooled, the better it will preserve its sweetness. The presumption is that the evolution of living organisms, which set up fermentation, is arrested; but, so far, this has not been proved. In the Lawrence Cooler the milk is poured into the receiver at the top, it passes over the refrigerator, which is charged with cold water, and immediately runs out at the bottom into the railway

churn or whatever has been provided for its reception. A great advantage of the Lawrence machine is that it also aërates the milk, and that the cooling is gradual, for as the cold water enters at the bottom and the milk at the top, both meet at those points at which they most approximate in temperature.

In Kent's *Cooler*, which may also be utilised as a churn, there are two cylinders, one of which is fitted with a tap at the bottom for drawing off the milk, and a couple of connecting tubes, top and bottom, which enable the milk to circulate between it and a second and smaller cylinder, which contains the cooler, and in which cold water or ice is placed. The milk is poured in the large cylinder, filling it and the smaller one to the same level—the top of the higher connecting tube. The milk in the smaller cylinder will be much colder, in consequence of the presence of the cooler, and consequently, being denser, will sink and find its way through the lower connecting tube; the warm milk will at the same time flow through the top opening, and sink in its turn; thus circulation is kept up.

Fitches' *Simplex Cooler* is a less costly article than the above; it is simple and can be easily worked. It is really a coil of pipes, which are placed in the milk. When in operation, cold water is run through—the pipes being connected with a tank by means of an india-rubber tube. The milk is by this means reduced to about 45° Fahrenheit; a very valuable temperature.

The most recent invention for the purpose of cooling and aërating milk is an apparatus called the *Temperer* (Fig. 64), which was invented by Dr. Bond, of Gloucester, well known in connection with the first Dairy Farmers' Conference. It consists of a refrigerator and a reservoir, and is complete in itself, the only further requirement being a supply of water, which can be conveyed to it either by hand or by a pump. The refrigerator, which is a circular vessel of 12 inches in height by 18 inches in diameter, may be stood on the top of any convenient support, according to the height of the churn or other receptacle to be filled from it.

It has three or more chambers of lenticular shape, which are placed on, and communicate with, each other. An outlet and an inlet allow the passage of water through the interior, while the milk to be cooled flows over the exterior. There is also a special internal arrangement for the circulation of the water, the latter being conveyed from the reservoir, close to which the refrigerator stands, by means of an elastic tube. The

Fig. 64. Dr. Bond's Milk-cooler. 1, Lawrence's Cooler on reservoir 2, Dr. Bond's Temperer on (3) Barrel; 4, Milk-receiver; 5, Churn receiving cooled milk; *a*, Milk-flow Taps; *b*, Water-flow Pipes; *c*, *d*, Water-outlet Pipes.

reservoir holds 50 gallons or more, according to size, and can be supplied in the manner found most convenient. It consists of an iron tank, and is provided with an arrangement by means of which the refrigerator is constantly supplied. The milk to be cooled can be placed in a vessel above it, so that it will flow into the receptacle on the top of the refrigerator, but no reservoir is necessary where water is laid on by high-pressure supply pipes,

or where a tank already exists It is claimed on behalf of this Temperer that it will give as good results as it is possible to obtain by any appliance from a given quantity of water under any combination of conditions, and that these results are equal to those obtainable from much more expensive appliances. The price of the refrigerator is £2 10*s*., according to the size, and of the reservoir holding 50 gallons, with milk vessel complete, £3, or holding 100 gallons, £4. Those who have used it testify that they are well satisfied with it, one gentleman remarking that with 2 gallons of water at 50° he cools a gallon of milk per minute to about 60°.

A *Mélangeur* (Fig. 65) or Milk-Mixer, which is made of tinned iron, and has a capacity of from 66 to 220 gallons, is used in many establishments abroad. It consists of (1) a round receptacle (M) of the above capacity, supported by a strong tripod, and raised to a sufficient height to allow a can to be stood under either of the two taps with which it is provided; (2) a strainer (B) to which is attached two hooks (C) for holding it in position, and to which a *hausse*, or false ring (H) is fixed. It is customary, when the second receptacle above mentioned is fixed in its place, to pour into it the milk of the evening, and then the morning's milk, which has been both heated and cooled. The sieve retains all impurities, and any other matter which has separated itself during that process. The whole is then intimately mixed by stirring, the taps turned on, and the cans filled, sealed up, and the contents dispatched. The machine is intended not only to mix the milk, but to obviate, as far as possible, the addition of water.

Bottles and *Jars* are now much used for the conveyance of milk and cream. They were the fashion in Paris a long time ago, and at last British makers have taken them in hand, so that in time we may hope to see them generally adopted. The chief difficulty seems to be that rubber and cork absorb the milk, and so contribute to the difficulty of keeping it sweet; but it is stated that if the cork used is soaked in pure paraffin—the fatty substance

obtained from crude petroleum—it will be incapable of absorbing anything. The *Warren* glass jar sent out by the Aylesbury

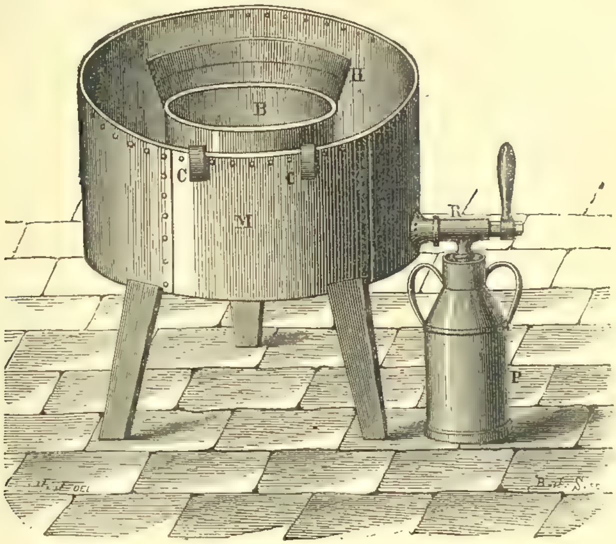

Fig. 65. Milk-mixer.

Dairy Company is a very good one; it has a glass stopper closing upon a cork ring, and can be opened and closed without detaching

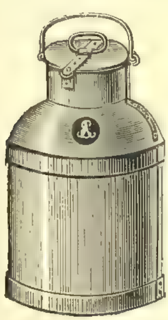

Fig. 66. French Metal Cream Bottle.

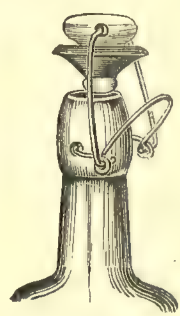

Fig. 67. Lipmann's Stopper.

the stopper. The mouth, too, is 1½ inches wide, so that it is easily cleaned. These bottles, quart size, cost about 14*s.* the dozen.

The best milk-bottle made is that of Lipmann & Cohn. This

was shown us by the makers in Berlin in 1883, and by their courtesy we are enabled to illustrate the admirable stopper affixed to it. It is strong, easily opened and closed, and keeps the milk air-tight.

Rylands, of Barnsley, also makes a valuable milk-bottle. It is of flint-glass fitted with a glass stopper, in which are two ingenious catches. The stopper fits into a cork or rubber ring, and when the catch is down, it is pressed so tightly that air is excluded. The producers' label on either of these stoppers would make them proof against theft or adulteration.

Butter-workers are now so generally used, that a description of the best known will be of use. In every dairy where a quantity of butter is made, machines are necessary for its manipulation, not only on account of the saving in time, but because it works out the buttermilk so much better than the hand, and obviates any possibility of injurious effects which are often imported by the latter. In all dairy utensils two things are necessary, simplicity in the working, and facility for cleaning. A very slight trial will show any one who has not been in the habit of using a butter-worker, how superior it is to hand labour, how much better it amalgamates the butter, and how superior is its grain when compared with that made in the ordinary way. To large makers it is invaluable, enabling them to mix their different churnings, and to salt with greater perfection. One of the very best machines is the "*Embree*" (Fig. 68), which is of American manufacture, and which gained the prize at the Centennial Exhibition. It was introduced into England at the Royal Show, at Kilburn, by the Aylesbury Dairy Company, and was much praised. The Embree resembles a round table, which is turned by a winch. The butter is placed upon it, and passes beneath the workers, requiring very little manipulation in any other way. The *Circular German* worker, of the Dairy Supply Company, works upon a similar principle, and is a good machine, although not so simple in its mechanism. It kneads the butter satisfactorily, giving it a uniform quality, preserving its grain and expelling the buttermilk.

A smaller machine is the *Cunningham*, which is both useful and cheap. It is one of the latest machines, and has a reversible action, which enables it to collect the butter when it is worked—a very great advantage. The Aylesbury Company's "*M M*" is also a valuable worker, somewhat similar in principle. For factory or very large dairy working, this company has a large machine which is suitable either for hand or steam power. This machine does its work without subjecting the butter to

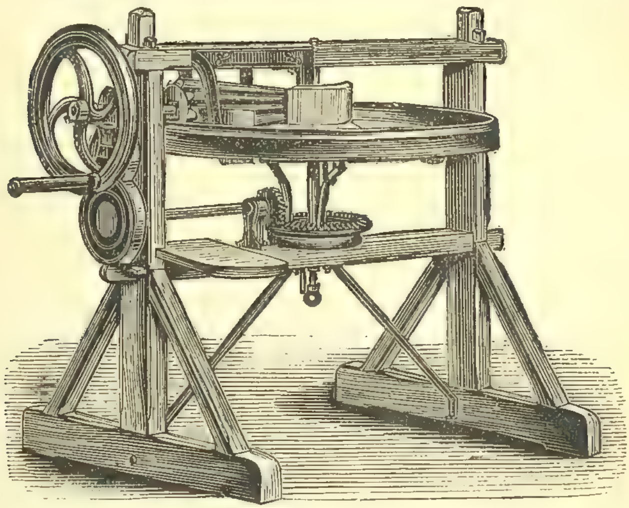

Fig. 68. The "Embree" Butter-worker.

compression between revolving rollers with smooth surfaces—which, it is said, makes it oily. In working, the butter is placed in a hopper, and thence passes between fluted rods which divide it into pieces, delivering it into a shoot, whence it passes into a tub. Here it is worked by beaters, which revolve until the attendant sends it into the box below. The machine permits the removal of any butter which adheres to the beaters in the sides of the tub while it is working. Should it be necessary for the removal of salt, or for any other purpose, a flow of water can be directed through the hopper and right into the kneading tub,

whence it escapes through the same passage that the butter passes through into the box.

Llewellin's *Continental* is somewhat similar to the *Embree.* It is a rotary machine, and requires but a dozen revolutions, taking some four minutes, to well make the butter. The gear is at the side of the table, and from here the leverage is obtained, instead of at the top as in some machines.

Reid's *American* is a simple and yet useful machine, costing but little, and yet doing its work well. It resembles a tray with a

Fig. 69. The Blanchard Butter-worker.

roller on which paddles are fixed, and which traverses the whole length of the tray. It is well and strongly made, and the iron-work is galvanised.

The *Eureka* works on a different principle, and the worker is, in fact, a heavy roll which works on a bracket. It gives a gentle, even pressure, can be worked rapidly, and the tray can be utilised as a table upon which to make up the butter.

The *Blanchard* worker is an American implement, quite

novel in design, and extremely simple. That it expresses the butter we have no doubt, but whether it is a thoroughly practical system we have as yet no means of knowing.

Bradford's *Springfield* machine is another rotary, not unlike the *Embree* in appearance, but the table, instead of being convex, is concave, or lowest in the centre. It has obtained high honours in competition, and, taken all in all, is a first-rate machine.

Messrs. Bradford brought out a new rectangular butter-worker at the London Dairy Show, in 1882, which was awarded

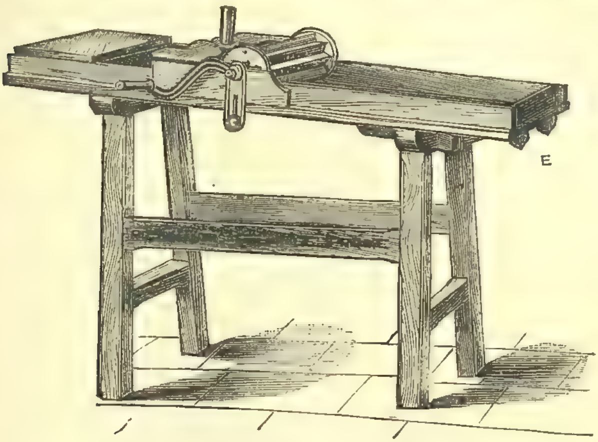

Fig. 70. The Williams Butter-worker.

the second prize, although we thought it the best machine then produced. It is an improvement upon the *Cunningham*, and can be used as a plain table, at any time when not in use for working the butter. Williams, of Frome, has recently introduced a new machine of this class, the special features of which are that the roller is smaller in diameter in the centre than at the sides, while it is kept in firm position by an elastic spring. It is one of the best in the market.

The *Lever* worker is an inclined board with bevelled sides, which run down to the lower end to within a few inches of each other. At this point is a socket, in which a wooden lathe is

fitted, and with this the butter is worked. *Butter-boards* are the smallest and cheapest appliances, and are more generally used in very small dairies. At one end is a pair of legs, the other end resting upon a table or shelf. Upon this board the butter is worked by a fluted roller specially fitted for the purpose.

The illustration (Fig. 71) is that of a butter-mixing machine invented by M. Hauducœur. The butter is placed in the hopper

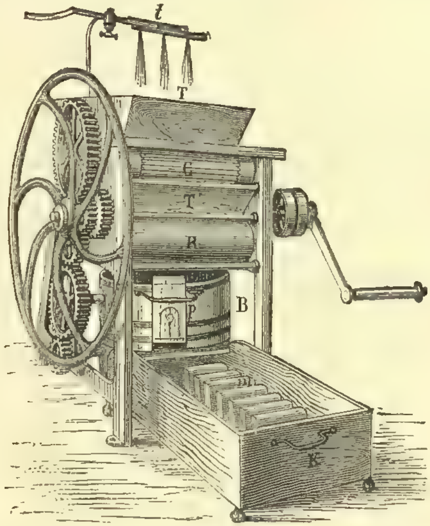

Fig. 71. French Butter-mixer.

(T) and falls between, and is partially worked by, two parallel fluted rollers (C). It then passes into a second hopper (T′), and next between two other parallel rollers (R), these having a smooth surface It afterwards falls into the tub (B), in the centre of which is a vertical column furnished with arms, which are fixed diagonally. There are also four horizontal arms fixed to the sides of the tub, so that the butter is thoroughly well worked, becoming quite homogeneous. It is gradually carried to the door (P), whence it falls in rectangular slices into the

box (K). By means of the jets of water (*t*) the butter can be washed, salted, or coloured.

Butter-presses are in use in some large dairies, where the butter

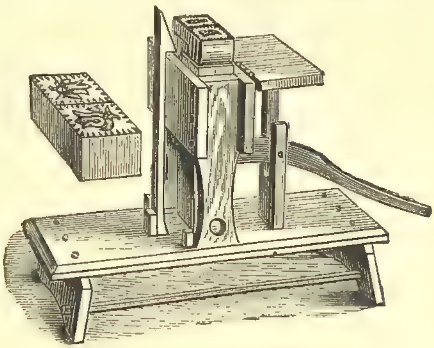

Fig. 72. English Butter-press.

is nicely turned out for market in the tasty forms so common in the best London shops. Thus, foreign butters, which arrive in

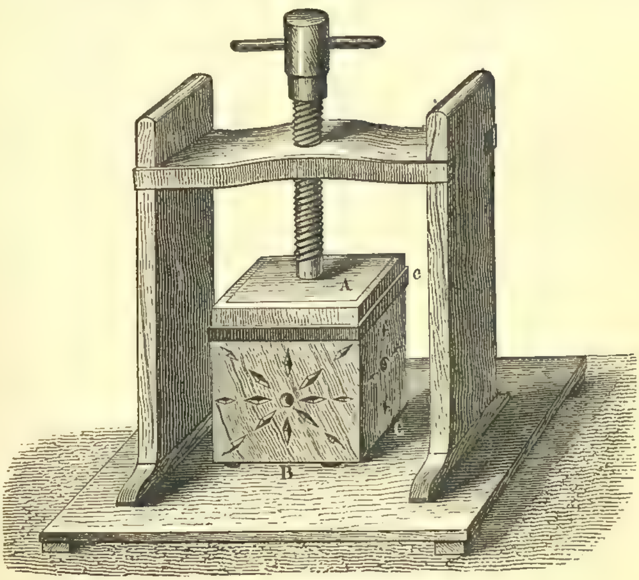

Fig. 73. French Butter-press.

tubs or kegs, are made up into attractive pounds and half-pounds, realising a higher price than if weighed in the shapeless lumps common in cheap districts. No doubt plenty of dairymaids can make up butter in a clever manner, but it is impossible to give it that finish and uniformity, or to turn it out so rapidly, as in these presses. Any one can work them, as they are exceedingly simple, and by no means expensive; whereas, to do the work by hand requires some dexterity and considerable practice.

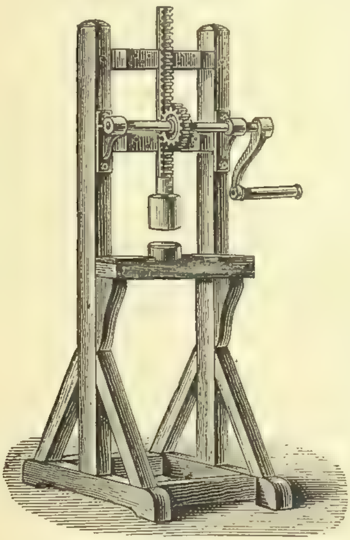

Fig. 74. Ahlborn's Butter-press.

A very useful instrument, which has been invented by M. Pellegrin, a French butter merchant, is shown in Fig. 73. It is especially adapted to the French system of sending out butter in large lumps. The four side faces, B, C, D, and *e*, are hinged to the bottom, which is a similar piece of wood pierced with holes, and, when open, they all fall back upon the table. The lump of butter is placed in the centre, and the sides are shut up and covered with the lid A, which keeps them in their places. The screw is then used, and the butter pressed into form, a large quantity of buttermilk at the same time being expressed. Each time the press is employed it is necessary to drench it with water to prevent the butter adhering to the sides when it is next used.

Milk-pails are necessary in all dairies, some persons using those of metal, others of wood. There is some advantage in having them gauged; and nowadays every really enlightened dairy farmer keeps himself *en rapport* with the value of his cows as milkers. This he is the better able to do if his pails show at a

glance what the animal has given. Among the best pails are the *Cheshire* (Fig. 75) and *Byrd's Patent.* The latter is a plain utensil, sloping to one side, and it need not be placed so far beneath the cow. Whether pails of tin, iron, or steel are the best we need not inquire, as all are good, price regulating their strength and durability; but we certainly think them all superior to wood, which is porous, and consequently necessitates a great deal of labour in cleaning.

Fig. 75. The Cheshire Pail.

Burns makes a very good pail, which holds a large quantity, and is not easily overturned. It is made in two forms, one as shown in the illustration, and the other with a handle within the pail at the side. A more convenient pail we have not seen.

An American pail, called the *Perfect*, was sent over in the collection of 1879; the pail and its lid formed the seat of the milker, the milk being drawn into a funnel connected by a rubber tube, which is fitted with a strainer. The latter, we rather think, is out of place, as, although it might catch any foreign particles, it would not remove them; at all events, as such a pail prevents the likelihood of the loss of milk by a kicking cow it has much to recommend it.

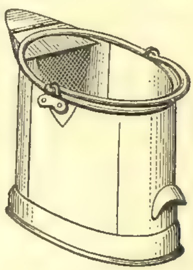
Fig. 76.
Burns' Milk-pail.

Pails for the cow-house should be of strong galvanised iron, large and well-riveted, and not too expensive.

It is the practice in many large establishments to weigh the milk, as its value is believed to be more correctly estimated by weight than when it is measured. To this end the Aylesbury Company sends out a first-rate machine, which is highly finished,

and very reliable. The vessel in which the milk is placed, is of tinned copper, and the stand is of solid oak. The Dairy Supply have more recently turned out a milk-weighing machine which, if smaller and less elaborate, is much less expensive.

Milk-Balance.—The milk-balance or weighing-machine made by MM. Renaud & Bailly-Comte, of Morez, Jura (Fig. 78), is an extremely good one. There is a large swinging metal pail which hangs from a spring, to which a hand is attached, so that when the milk is poured through the sieve or strainer which is fixed above the pail, the hand immediately moves along the face erected

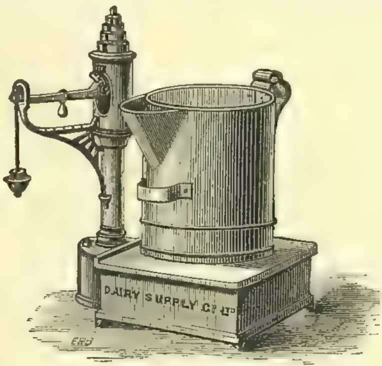

Fig. 77. Barham's Weighing-machine.

above it, and shows the quantity the vessel holds. The price is 70 fr., which is exceedingly reasonable.

Strainers are of various kinds, and are one of the most necessary articles in a dairy. There are many persons who neither care to cool nor aërate the milk; but even the most slovenly strain it, if only through a cloth. A common strainer is of tin, larger at the top than at the bottom; it is fitted with muslin, cloth, or wire gauze, the latter being preferable, as it is more quickly cleaned, and wears for a long time. In another make, the sides are also of wire, which is an advantage, as the milk is enabled to escape more freely, and does not carry impure substances and hairs with it. A more expensive strainer is the

Pyramid, in which the wire is placed in pyramid form. This is a decided improvement, and can be confidently recommended.

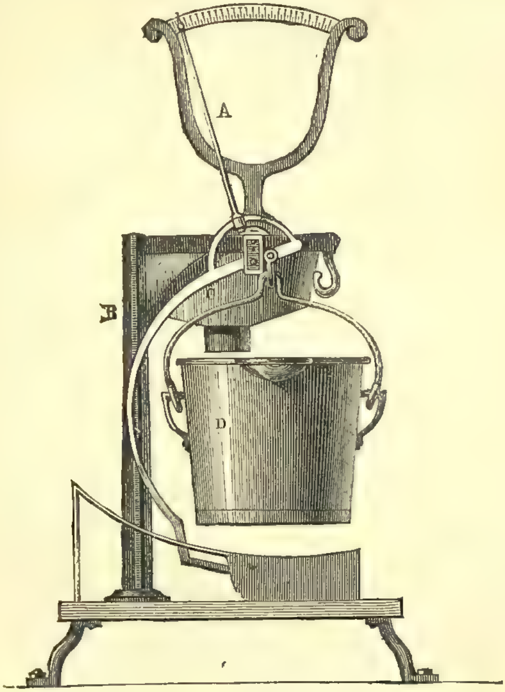

Fig. 78. Milk-Weighing Machine.

Especial strainers are made by the best manufacturers, suitable to the deep-setting cans.

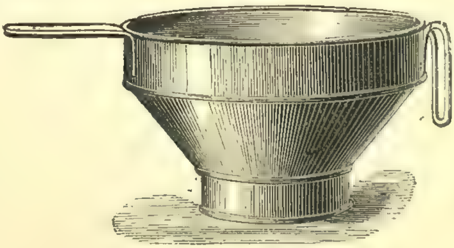

Fig. 79. Milk-strainer.

Skimmers are of various patterns, varying in shape from a spoon to a scallop-shell, and some are of tin, while others are of wood. The latter are chiefly used on the Continent, and beautifully as they are made, they require more dexterity in use

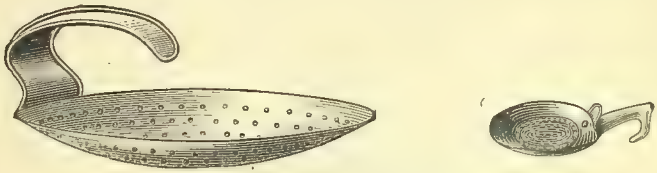

Fig. 80. Cream Skimmers.

than the common concave perforated tin skimmer so much used in England.

Cream-cans are generally of tin, with handles and lips; but we like the common glazed pans as well as any. Both are simple and easily cleaned, and it is a matter of taste which is preferred.

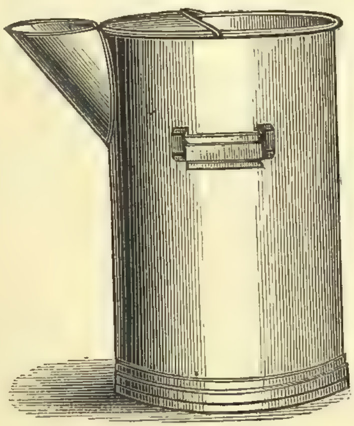

Fig. 81. Cream-can.

The *Fairlamb Cream-can* shown at Fig. 82 is an implement peculiar to the creameries or dairy factories of America. The idea of its inventor was to enable factory owners to conduct their business without the necessity for gathering milk, or requiring the farmers to deliver it, as they would often have to do, considerable distances. Mr. Fairlamb constructed a can of a particular size, which would admit of an inch of cream making a pound of butter, and, from particulars which he has sent us, this appears to be a fair average quantity. An instance is given in which one factory made 50,000 lbs. of butter from 49,000 inches, or gauges of

cream. This can is made by Messrs. Davis & Rankin, of Chicago, who inform us that when a factory is started it purchases five hundred or more of the Fairlamb cans, which are immediately sold to the farmers. The factory team goes round once daily, buying up the cream by the inch, as indicated by the gauge fixed in the side of the can. In the centre of the can is a column which is filled with cold water for cooling the cream, and it is claimed that this is more effectually done than by cooling the sides. This system has not yet, we believe, been adopted in this country.

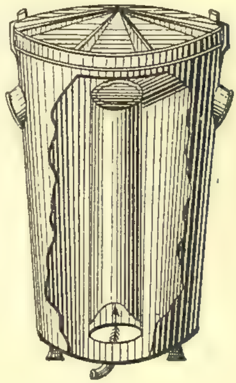

Fig. 82.
The Fairlamb Cream-can.

The *Fairlamb Cream Transport-can* is quite a new idea, and is in use in America, but has not yet found its way to England. It is made of galvanised iron, and is provided with an inner jacket of tin, allowing an air space of half-an-inch between, thus preventing leakage and keeping the cream thoroughly cool. The bottom is of wood, bound with an iron hoop. A funnel is used in filling, the cream passing through the convex-shaped lid.

Fig. 83. Butter-trough.

Butter-tubs are often of use, especially for washing the smaller utensils in the dairy, or for dipping them in when using.

A *Butter-trough* too, is a valuable adjunct where more elabo-

rate appliances are not used. It can be obtained of any size, and of lindenwood, with or without a frame. Patters, beaters, and *Scotch hands* as they are sometimes called, are also invaluable, and should be of either sycamore or boxwood. Moulds, prints, and rollers for making up the butter, are made in great variety; and in purchasing it should be seen that they are of solid hard white wood, without any flaws.

Prizes for a *cow-milking apparatus* have been repeatedly offered, but we believe up to the present time no perfect machine has been invented. The best are *Barland's* and *Durand's*. The former is exceedingly simple; it consists of four electro-plated

Fig. 84. Scotch Hands.

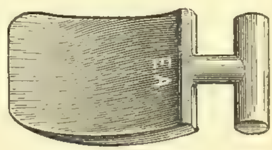

Fig. 85. Butter Spatula.

tubes, an inch long. By grasping the teat, as in milking by hand, its mouth is opened; into it is then introduced the slanting end of the tube, care being taken that it is gently done and with a rotary motion, the tube being previously wetted. This little apparatus is useful in case of sore teats, and under conditions where ordinary milking cannot be satisfactorily performed; and it is also very cheap, but it is not likely to supersede hand-milking.

The *Durand*, although so far incomplete for offering to the public, bids fair to become one of the most valuable adjuncts to the dairy farm. It will, it is believed, cost £10, but the inventor has in contemplation a smaller utensil acting on the same

principle, to cost £2. As there is considerable merit in the invention, and a great probability that it may find its way into the market, we quote a description of it from the pen of Professor Alvord, one of the foremost dairy scientists in America. He says:

"Mr. Durand began upon the basis of the Colvin patents, adopting the principle of suction or pumping. He is the inventor of one of the best breast-pumps for the use of human kind, and his cow-milker is substantially a quadruple breast-pump. In the course of his work, it soon became apparent that to give ample relief from hand-milking, a machine operated by power was wanted rather than a hand-machine. Next, as a power machine could not well be moved from cow to cow, it must be arranged for the animals to be brought to it successively. Accordingly, a stanchion was built, much like the usual stable fixture—with or without a feed-box (preferably without) and by a very simple device—the cow being driven to the proper position—the pulling of a cord fastens her in the stanchion. The milking done, another cord may be pulled, and by it the stanchion opens outward in front of the cow, and the animal passes forward through it to stall or yard, another cow coming up behind to take her place. It is intended to place the stanchion in a passage way, to be approached by the cows from their stalls after feeding, and, perhaps, to milk them as they successively pass out to water. A single machine attached to the stanchion, may be operated with a hand-wheel, or by attaching to a pulley and shafting. Two or more such stanchions may stand side by side, and, if power is used, with movable pulleys one man would be able to tend at least four.

"The milking apparatus is attached to a post on the right of the stanchion, and this post is pivoted at the top and bottom, so that the milker can swing horizontally, with additional provision for raising or lowering the whole. This enables the operator to carry the machine to the udder of the cow, standing in any

position possible, while held by the stanchion, and it is adjustable to a cow of any form and size. The part of the milker extending from the post may be called the arm, and the portion in contact with the udder, the hand. The arm has compound joints, like the elbow and wrist, to help to place the hand properly and keep it in place. The hand carries four diaphragm exhaust pumps, and above each pump is a teat-cup. These cups are much better adapted to their purpose than those made for previous machines of this kind. They are made of rings of hard rubber, like the travelling or picnic ring drinking-cups, and not only can be slipped up over the outside of teats of unequal size, so as to fit all and hold them closely, but are arranged to do their work whether the teats are far apart or close together. As each teat-cup acts independently of the rest, the four may be milked at once, or any one or more separately, without changing the machine at all. The milker has thus an important provision for enabling it to be used upon double-teated or three-teated cows, and those which give more milk from some 'quarters' than from others.

"Adjusted to the udder, the fly-wheel is started, the pumps act, and the milk is drawn intermittently, like calf-sucking and hand-milking, from one teat or more, two on a side, two across, or all four at once. The milk from the four pumps flows into a single flexible tube, which passes along under the arm, and enters a large can set in the floor near the foot of the post supporting the milker. The can is closed, and no air comes in contact with the milk. The udder being well cleaned to begin with, a more cleanly process of milking is impossible. The person operating the machine has perfect control of its varied actions without disturbing the cow. One hand, if there be no power, will turn the wheel, while with the other a lever can be worked in connection with link-gearing, so as to give the 'hand' vertical or lateral motion, thus boxing the udder in a manner very closely resembling the natural action of a sucking

calf. There are other details of the machine which cannot be well described. Indeed, this description is necessarily imperfect, and its length will give an idea of a much more complicated apparatus than Durand's Milker appears to be when examined and used. The machine is simple in its mechanism as a whole and in parts. It can be kept clean easily, washing in cold or hot water, and is not liable to get out of order. From 3 to 5 minutes suffice to milk a cow with this implement; an average of 4 minutes, adjustment and all. As to its work, I can only say that it has, at different stages of its construction, been tested by use upon numerous cows, and found to draw all the milk, to do it quickly, and without more opposition on the part of the cow than is usually manifested when a strange milker, man or maid, appears in the stables."

Thermometers are most necessary in every dairy, and although professed hands are able to judge very correctly whether the cream is at the right temperature for churning, yet we counsel all to rely on this instrument, and it alone, if they wish to be always on the right side. There is, however, another instrument which is very necessary where stock is kept, a clinical thermometer. Most cowkeepers will have seen it used, as it now invariably is in diagnosing disease. To Professor Gamgee we are indebted for its introduction, and for the salvation of many valuable lives; therefore its value cannot be over-estimated.

There are three systems of indicating heat by the thermometer: That of Fahrenheit of Dantzig, which is in general use in Great Britain, in which the scale runs from 0° up to 212°. The inventor fixed upon the temperature of a mixture of sal-ammoniac and ground ice as his point of departure—hence 32° is the ordinary freezing point, and 212° the figure at which water boils. Next we have the system of Celsius, a Swedish physician, which is known as Centigrade. In this the scale is divided into 100 parts: water freezing at 0° and boiling at 100°. Lastly comes the system of Réaumur, a French physician, which is

divided into 80 parts: water freezing at 0° and boiling at 80°. The last two are generally used on the Continent, Réaumur in Germany, and Centigrade in France. In comparing the three

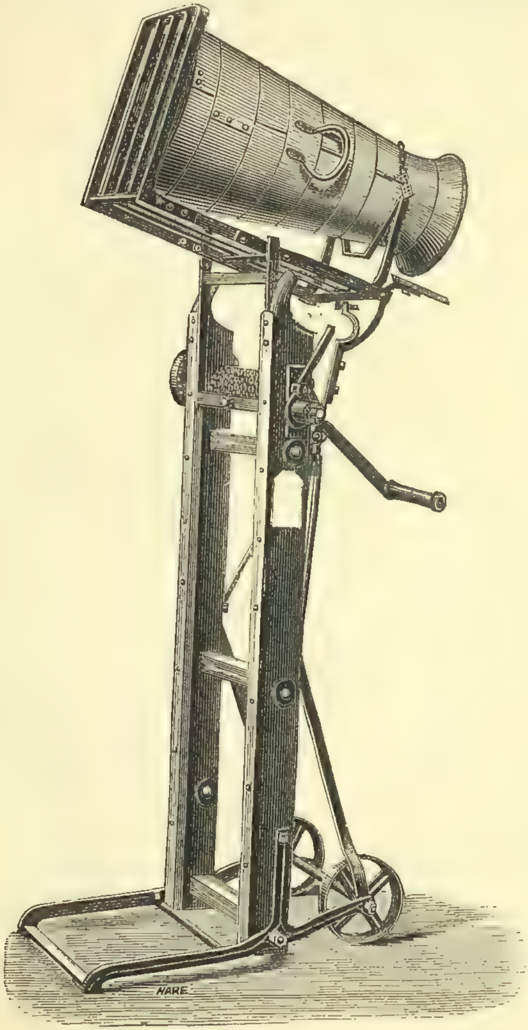

Fig. 86. Milk-elevator or Churn-lifter.

systems, it will be seen that 5° Centigrade equal 4° Réaumur, while Réaumur may be converted into Fahrenheit by multiplying by $2\frac{1}{4}$ and adding 32°, unless below freezing point, when 32° is deducted instead. Centigrade is converted into Fahrenheit by multiplying by $\frac{4}{5}$ and adding 32, or deducting 32 if below freezing point.

Churn-lifter.—The appliance illustrated at Fig. 86 is very ingenious, and adapted for use in large dairies or factories where churns of milk are moved, and where they are required to be emptied at an unusual height. The idea is evidently borrowed

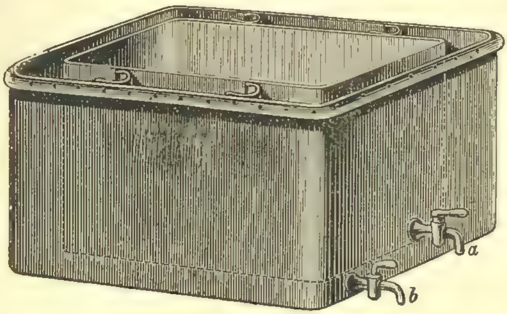

Fig. 87. A Factory Milk-vat.
a, Tap for Milk ; *b*, Tap for Water.

from the now well-known sack-lifter. The churn is wheeled on the barrow, and lifted by turning the handle, when, by a simple contrivance, it is tilted over, and its contents emptied into a reservoir or milk-vat.

Railway Milk-churns are among the costly items in a milk-seller's business; but be that as it may, it is true economy to buy the best, although the most expensive. The usual churns are made of tin, bound with iron, and fitted with double lids. Others are made of tinned steel, and are lighter as well as stronger than those of tinned iron, and not very much more expensive. Mr. Marsden, of Worksworth, recently invented a churn of which the entire bottom is constructed with a flange, for attaching the

body in one continuous iron casting. A churn upon wheels has been invented by Mr. W. Legge, of Berkeley. The can bottom

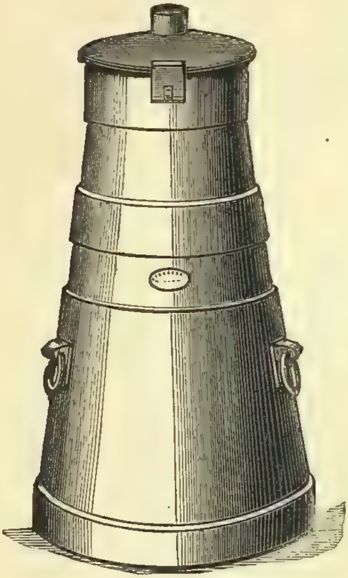

Fig. 88. English Churn.

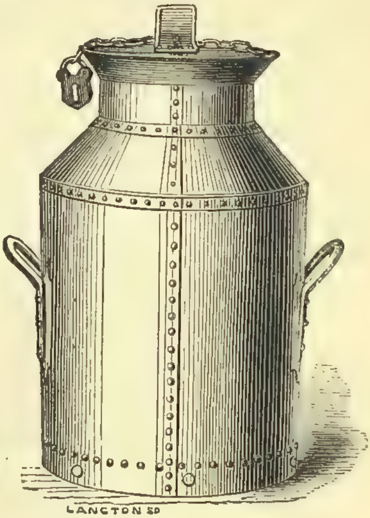

Fig. 89. German Churn.

has a flange, to which is attached a hachet supporting a small axle on which the wheels are fixed, and which is placed at the back edge of the bottom of the can, the front edge being provided with feet, upon which, with the wheels, it can rest.

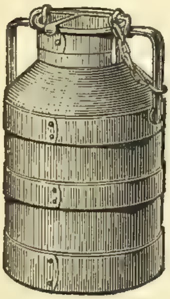

Fig. 90. French Churn.

In purchasing these churns it is well to remember that if the ventilator on the lid is higher than the rim, it is unprotected, and liable to be knocked off; also, that if the lid is fitted below the rim, any rain falling upon it finds its way into the milk. It is a good plan therefore to have a rim to the lid, to prevent this, and one or two makers have adopted this idea. Care should also be taken to see that the bottom of the can is very substantial. The Bessemer steel

churns introduced by Mr. Barham are as perfect as any yet made.

Preservatives for milk, butter, etc., are not very numerous, but one of the best is the Aylesbury Company's *Omnium*, of which 1 oz. is required to 14 lbs. of butter, or only one-half the quantity, if the butter is not required to be preserved above a few weeks. This preparation has successfully preserved well-made samples for a year, even when they have not been hermetically sealed.

Glacialine is another valuable antiseptic, 1 oz. being sufficient to preserve 6 gallons of milk, or 12 lbs. of butter.

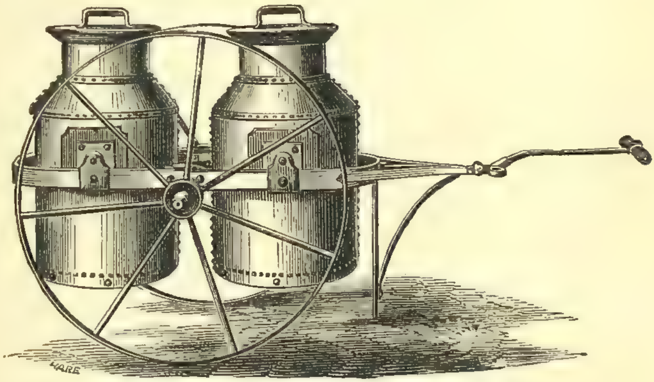

Fig. 91. German Churn Perambulator.

Aseptine we have not tried, but it is spoken of in very favourable terms, and is without doubt a valuable preparation.

Before fitting up a model dairy, an intending purchaser would do well to visit one of the principal exhibitions, or the dairy shows where these are shown. At the Agricultural Hall, in 1881, a number were exhibited, and among them were some which were very beautifully fitted up. The Express Dairy was furnished on the old system, but with marble stands, white china-lipped pans, a plain barrel-churn, and the Cunningham butter-worker, the walls being of green and white tiles with ventilators fitted, and the floors supplied with an approved system of drainage. Bradford's

was one of the most complete; the tables and utensils all being of wood. It was provided with a refrigerator—the *Cooley* system—and the Springfield butter-worker, while in the centre was a stove; water was laid on, and the whole was fitted with blue and white encaustic tiles. In 1882 this firm obtained the first prize; one of the chief features being the ventilator in the centre of the dairy, which was explained to us by the inventor. In another instance tin pans were used to illustrate the open-setting system, whilst Mr. Ahlborn, a German exhibitor, showed in his dairy the *Swartz* system with slate tanks.

CHAPTER XV.

CHEESE-MAKING APPLIANCES.

In this chapter we have endeavoured to describe the best apparatus and utensils in the market up to the publication of this work, and our unusual opportunities have enabled us to speak with confidence, for in almost every instance we have either seen the different articles in use, or examined them so completely that we are fully satisfied of their value. In these days it is necessary to produce the best cheese, if success is to be attained, and to do this not only must the milk be good, but the utensils perfect. Good machinery is the cheapest, if only because it saves so much time; more especially is this so in the case of cheese-making appliances, a complete set of which can be purchased for a very reasonable sum.

Vats and Setting Apparatus.

A very good vat, with apparatus and steam connection, is made by Ahlborn, the well-known German maker. Indeed, the whole of the appliances of this gentleman's design are clever; price being, as far as we can learn, the only objection. The vat can be used with hot water or steam; the temperature is regulated by cold water, a cylinder strainer, to which is a conical valve, carrying off the whey. It is double-cased, and therefore heats from the sides and bottom, and made in sizes holding

from 90 to 225 gallons. The apparatus for steaming, which can be attached to the vat, consists of a round steam boiler, with safety-valve, gauge, cistern, etc. It is safe, simple, and believed to be both economical and durable.

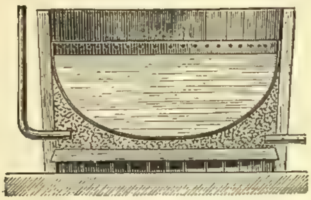

Fig. 92. Section of Ahlborn's Vat.

Wilkins and Son, of Calne, are the manufacturers of a steam cheese-maker, which we saw in operation at the London and Birmingham Dairy Shows, where it obtained Bronze and Silver Medals. It was also used at the Chippenham Show for making cheese from milk from which the cream had been extracted by the separator. It consists of the usual circular tub, with rotary curd-knives, draw-off tap, and tilting platform. The warming is

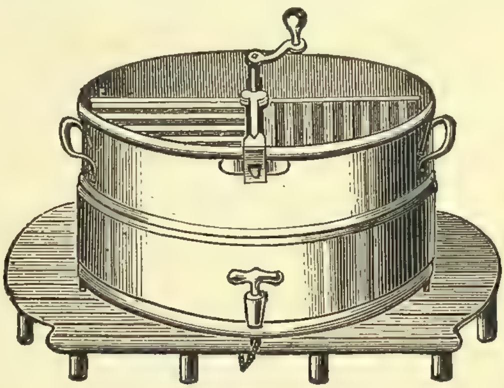

Fig. 93. Wilkins' Cheese-maker.

managed by steam, either under the bottom or in the copper chambers surrounding the tub, whichever is preferred. The boiler, which can be either fixed or portable, may be at any convenient distance from the dairy, iron and india-rubber tubes being used for the conveyance of steam to the cheese-tub. In perfecting this apparatus, which is now in general use in the

North Wilts district, the manufacturers appear to have succeeded in combining efficiency and simplicity. At the Birmingham Dairy Show, in 1881, Messrs. Wilkins' little dairy, fitted with milk-cooler, cheese-tub, and boiler, suitable for a "once-a-day dairy of thirty cows," was in motion, the fire and steam scarcely being observed by the passers-by. The same firm send out every kind of appliance in connection with the manufacture of cheese.

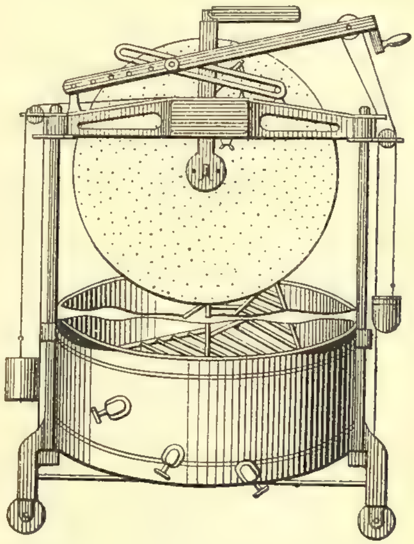

Fig. 94. Pugh's Cheese-making Apparatus.

Pugh's *Cheese-making Apparatus.*—Pugh's apparatus for making cheese is one of the best, perhaps *the* best, of those made in the circular form. It is generally made of metal, and is provided with taps at the side for drawing off the whey, as shown in the engraving. The pan can be emptied at pleasure, inasmuch as it can be tilted. The perforated round plate, which is shown lifted up and held vertically, is intended to press upon the curd, which it does by means of the patent lever at the top, and which is connected with a rod in the centre. This

plate can be adjusted to almost any position to be out of the way when the curd is being worked. The curd knives which are shown in the pan are made to revolve, and they do their work well; indeed, almost all the work connected with making British cheese which can be done in a round vessel, can be done by this apparatus.

Cluett's *Royal Apparatus*, now so well known as a prize-taker at all the leading shows, and which won two consecutive years both at the Royal and Dairy Shows, is an oblong vat running upon wheels. It is 7 feet long, 3 feet wide, and 19 inches deep; the inner pan containing 172 gallons when full. This admits of 150 gallons, or 3 gallons per day, from 50 cows, with a spare

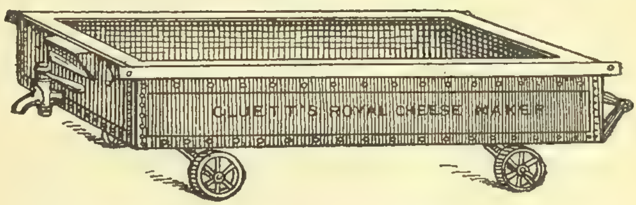

Fig. 95. Cluett's Cheese-vat.

working room of 22-gallon space. The above is connected with an outer body, in which cold water can be placed for cooling the milk, the same compartment being used for hot water or steam, as the case may be, for the purpose of heating up the milk for making, to any temperature. After passing off the whey from the curd, draining racks can be placed in the apparatus for draining. The whole is well made with the best material, and is most reasonable in price. When upon a commission in the Cheshire cheese district we found this alone, of all popular systems, in use, and the farmers could not speak too highly of it.

Corbett's *Apparatus* is another highly useful one in a cheese dairy. It resembles an oblong trough or tub, mounted on four legs, which are fitted with rollers to facilitate its removal from

place to place. It is 2 feet wide to 6 feet long, according to the size of the dairy for which it is required. On the bottom, inside the trough, a network, or ladder, of wood, of about ¾-inch square pieces, with openings of the same width, is placed, with bars passing from side to side, underneath which two supports of 1½ inches square are fixed the full length of the apparatus, thereby forming a drain for the whey to pass to the outlet at the

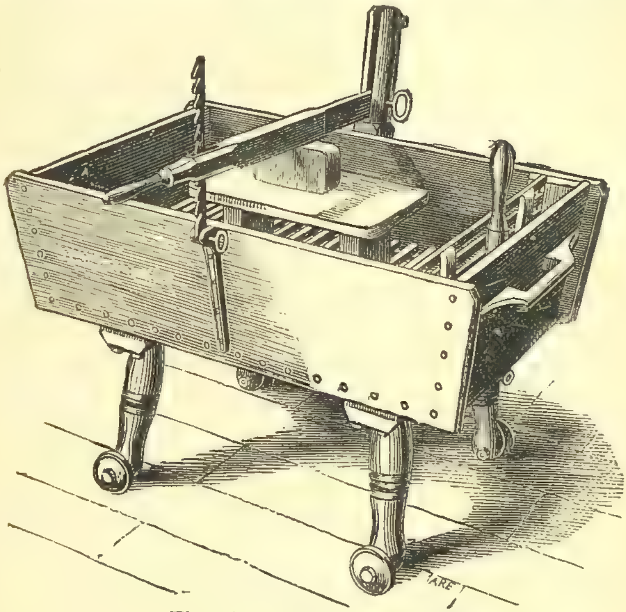

Fig. 96. Corbett's Apparatus.

end. On either side, and at each end, similar cratching is applied, the bars or pieces being placed in vertical position. An upright of wood, to which a lever is fixed, is placed on the side of the apparatus, while underneath a board is placed on the top of the cloth or bag which contains the curd and whey, and in accordance with the amount of pressure, so the whey is extracted, passing through and underneath the cratches on both side and bottom to the outlet at the end, and in a short time the curd is

ready to be placed in vats. This apparatus gained the first prize at the Royal trials at Oxford in 1870, and is described by the judges, in their report in the "Royal Agricultural Society's Journal" of the same year, as "a useful invention." The curd is lifted from the cheese-tub into the apparatus, the whey filters off, and the curd is cut, turned, and lifted out without waste. The price is very moderate indeed.

The Dairy Supply Association make an improved vat, which is built on the American model. The inner vat is of tin or copper, and the outer one of wood. It is made water-tight, and of the best materials. It stands upon six strong legs, and is powerfully made in any size, and especially adapted for steam. In America these vats are made in very large sizes, some containing as much as 500 gallons of milk. They are generally supplied with steam, which is conveyed between the cases by perforated pipes. We saw one of these apparatus at the Dairy Show, in 1879, where it was exhibited by Professor Alvord; but it was a small one, and was also fitted for cream-raising. Since then, the Dairy Supply Company have frequently exhibited them.

The Swiss vats, in which we have seen the manufacture of Emmenthaler and Gruyère cheese, are very beautifully made, and round in form. They are entirely of copper, larger in the centre than the top, where the largest measure about 5 feet in diameter. In these vats the curd is manipulated by hand, gathered adroitly in a cheese-cloth, the four ends fixed to a hook, which swings from a small crane, and it is at once hauled into the cheese-hoop.

Cheese-presses.

Corbett's *Double-Chamber "International" Press* is perhaps the most elaborate yet invented. It has taken numerous special awards at the principal agricultural exhibitions throughout the world, and is largely used in the colony of New Zealand. This

press takes two thick or several thin cheeses, which are placed in two compartments. Any required weight of pressure can be obtained by the compound lever, and the pressure on the cheese when placed in the press is continuous and equal over the whole

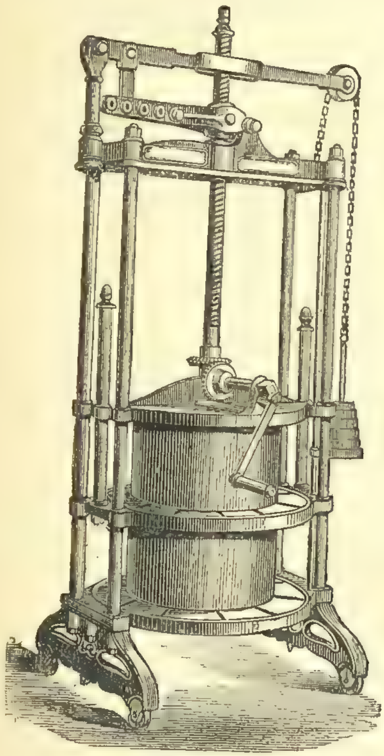

Fig. 97. Corbett's Press.

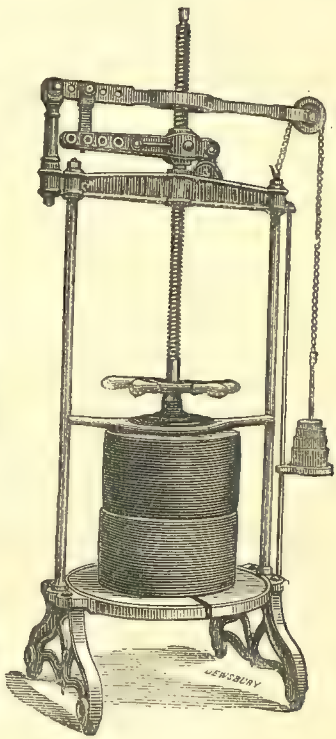

Fig. 98. Carson's Press.

surface and time it is in. The cheese or cheeses in one compartment can be removed without disturbing the other, which is a great advantage. To manage this, a loose iron collar, with set pin, is applied on each of the short centre uprights, and by placing these collars on the top of the casting, tightening the set pins, and turning the handle, the two castings are raised and the

bottom cheese liberated, the top one remaining undisturbed between the castings; and when it is required to remove the top cheese, it is only necessary to unscrew the set pins and turn the handle, which raises the top casting and liberates the cheese,

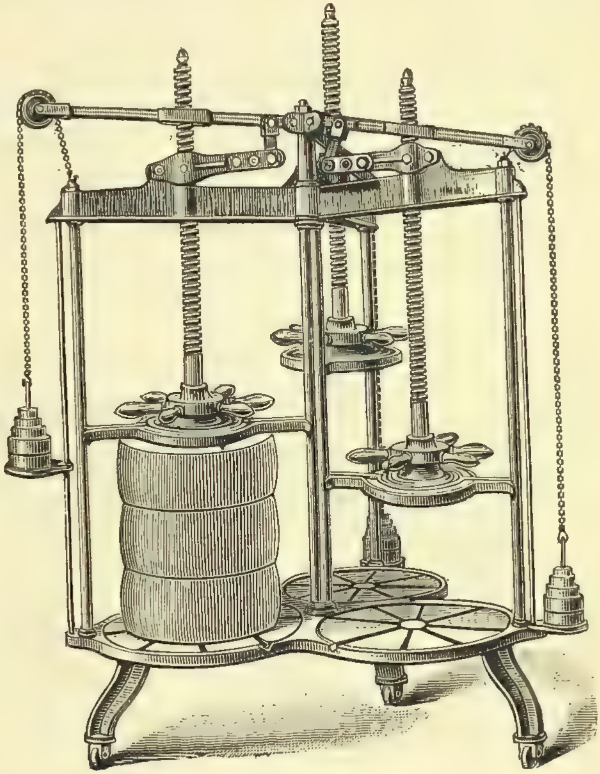

Fig. 99. Corbett's Triple Cheese-press.

the bottom one remaining fixed. This system is, we believe, applied to no other press. By way of obviating the use of portable boards, generally applied between the top of the cheeses and the castings, boards are introduced into the under sides of these castings, and are designated shooter-boards. The same maker's single-chamber press, has no intermediate bars or complicated

levers; it works with an extra strong screw, and is very reasonable in price. In the double-chamber press, which is similar in general design to the single, an intermediate plate is introduced, through which the standards pass to give it steadiness. This press is made in three sizes, and is of excellent make. Both the single and double cheese-presses by Mr. Corbett are of nice design, and of superior finish; and being mounted on rollers, are easily moved in the dairy. They are sold by many of the best makers, including Mr. Reuben Cluett, who strongly recommends them.

Lister's *Tubular Pillar Presses* are very generally known in the Gloucester and Somerset districts, and are made of strong welded iron. The long levers are placed underneath the stand—between the legs, instead of at the top, as is more general—and they are connected with the short lever at the top by a rod which passes through the pillar at each end of the press. At the end of the long bottom lever is a rod, passing up through the stand, and carrying a plate, on which the weights are placed. The weights are of three sizes, so that the pressure can be regulated with ease. No weights or levers project, so that no extra room is taken up. The presses are made on wood or iron stands, the latter being a trifle more expensive; and the double-presses, suitable for any sized dairy, are not compound, but placed side by side on one stand, each having its own screw and lever.

In Ahlborn's *German Press*, which gives a pressure of 6 cwt. up to 2 tons, the levers are at the top; the width is 22 inches between the standards, medium measurement. The prices are rather high, but the machine is a good one.

The Albion Ironworks Company make a very good double *Cheese-press* at a moderate price, nicely painted, and strongly made of iron. In size, it varies from 20 inches to 24 inches, between the standards. It has movable pins, shooter-boards under the top pressing-plate, and lever action at the top. The

pressure can be extended to 4 tons, and it is perfectly equal. There is a movable draining-plate, which admits of two thick or several thin plates being inserted. The machine is easily worked; it moves on rollers; and the range, as well as the amount of

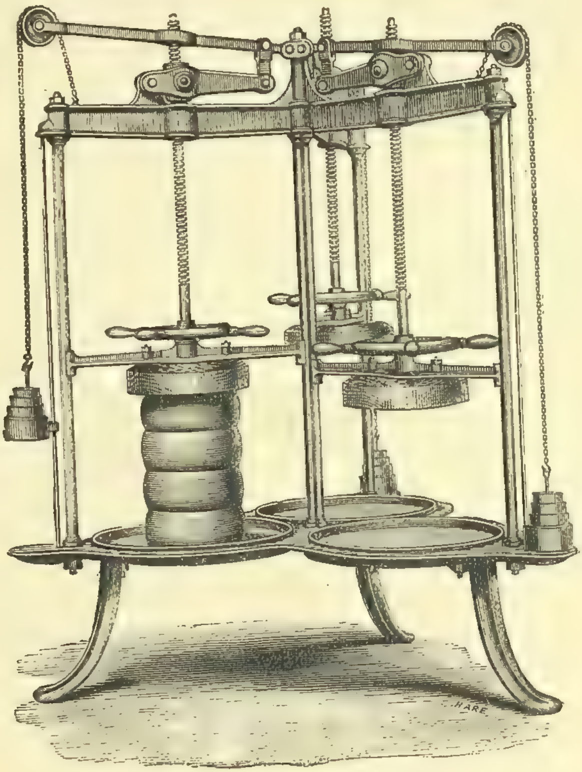

Fig. 100. Carson & Toone's Triple Press.

pressure, is readily regulated. In the Oxford trials, won by the Albion, the least weight applied to the levers to obtain the required pressure of 36 cwt., was 16 lbs. The same makers send out a cheap single press of similar manufacture.

The Dairy Supply Company send out very superior *Carson Presses*, which are particularly handsome and valuable. These

machines are lightly, yet powerfully made, take up little space, and the labour they entail is very small. The pressure on the cheese does not diminish as it sinks, but is continuous when the weights, of which 4 are supplied, are raised; the lever is at the top, and the press stands upon 4 curved legs. Double and triple presses are also made upon the same principle, side by side upon the same frame, but each is fitted with its own lever and weights.

Fig. 101. Cheshire Curd Mill.

Curd Mills.

Cluett's *Curd Mill* is a very good one. It stands upon iron legs, is well made, not easily got out of order, and is best adapted to the Cheshire and Cheddar systems.

Corbett's *Curd Mill*, a well-known prize machine, is on a wooden frame, which can easily be taken to pieces for cleaning or packing; especially as it can be packed into a small space for shipment. This mill, like the last, is largely used in the Cheshire district.

Bradford's *Curd Mill*, which is more expensive than the last, is well made; the fittings being galvanised, and the iron wrought. It is of the best seasoned wood, simple in construction, and not difficult to clean. The same firm make, at a little less money, a mill adapted for fixing on the top of a cheese-vat, and which is of considerable value to those who use it.

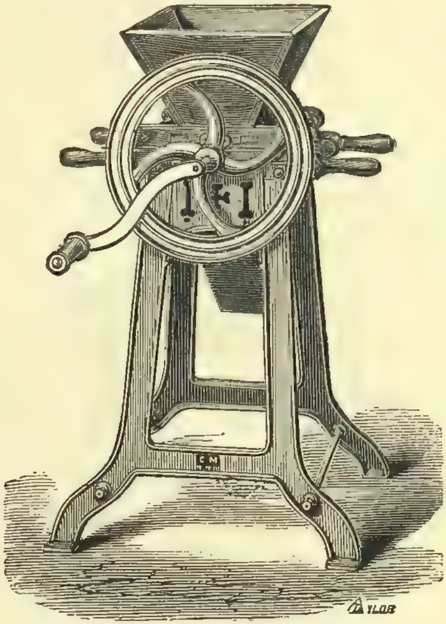

Fig. 102. Scotch and Cheddar Curd Mill.

Ahlborn's *Curd Mill* is fixed upon a cast-iron stand, the working parts being all of tinned iron. The roller, or spindle, works into a fine grating, the latter being fitted with a fly-wheel. The hopper and spout are of wood, and the mill is nicely made, but too much money for the small cheese-maker.

Lister's *Curd Mill* is wholly of wrought iron, except the tin hopper, and is galvanised after it is made. It is supplied in three sizes, suitable for dairies of from 12 to 50 cows, and at a most

reasonable price. The same firm send out a cheap cast-iron mill at considerably less price.

The Albion Iron Works' *Prize Curd Mills* are also low in price. In the smaller sizes the frames are of durable timber or cast-iron. The fittings and bearings are galvanised, and made so that it is almost impossible for them to get out of order. The *Cheshire* Mill has a large hopper, and works with a roller, the arrangement of the spikes in which give general satisfaction. One of the most novel mills, however, is the *Scotch and Cheddar*, made by this firm. Its design is good; it is on an iron stand; and fitted with a fly-wheel and spout at the side, which is by no means a bad idea.

Cheese Stools.

These little accessories to the cheese-room are most useful, as well as very necessary. They are generally made in 3 sizes, and of iron; some have, however, wooden legs and rollers, the legs being either 3 or 4 in number.

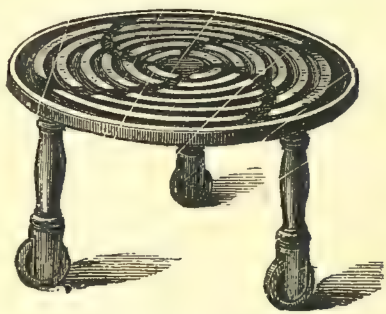
Fig. 103. Cheese Stool.

Corbett's are generally made with 4 legs of iron, and with roller feet; but this maker also sends out wooden-legged stools.

The *Albion* stools, on the other hand, are preferably three-legged, and made in both wood and iron at moderate prices.

Bradford's also make capital three-legged iron or wooden-legged stools, in 3 sizes, and with or without rollers.

Curd Knives, &c.

The knives sent out by the best firms are made both with vertical and horizontal blades, the former having 6, 10, and 14,

and the latter 35 knives, and measuring 8 by 18 inches. They are made after the American pattern, of the best steel, with sharp edges, and should be well tinned. This is very necessary, inasmuch as the active acid in the rennet would otherwise have a ready effect upon them.

Barham's *Curd Agitator* is made 4 feet 6 inches in length, with wooden handle and bottom, and with brass wire, well tinned. An agitator is sometimes made with a long handle, and with 14 bars across the bottom, in the form of a square shovel; but the modern patterns are preferred.

Curd-pails should always be made of tinned iron. Curd-scoops—and, in fact, every utensil which is of metal—should be of the same material. Most of these can be selected at the Aylesbury Dairy Company, or at the Dairy Supply Company, who have largely entered into the business in connection with these appliances.

Ahlborn makes a very ingenious *Cheese-turning machine.* It is largely used in France for turning cream cheeses up to 20 inches in diameter. While we can commend the cheese-turner, we do not think it is likely to become very popular in this country, as persons will generally prefer to turn their cheeses themselves.

Cheese-hoops are best made of galvanised iron, which is cleaner than wood, and enables the cheese to slide out much more readily. Cheese *thermometers* are always necessary; in fact, there is no instrument more valuable in a dairy. *Rennet measures*, too, are useful, and often save a waste and much trouble. Hansen's *Extract of Rennet* is most valuable, and is stronger, purer, and more simple than the majority of kinds in use; it is also reasonable in price. Many persons still make their own, but we question whether they are wise in so doing; for time is money, and rennet is cheap. We are not so sure, however, that the use of chemical fluids which are not rennet—which, in fact, are not made from the stomach of the calf at

all—should be encouraged; for as the action of calves' rennet is partially digestive and certainly distinct from that of common acids, it must necessarily be more perfect in its results.

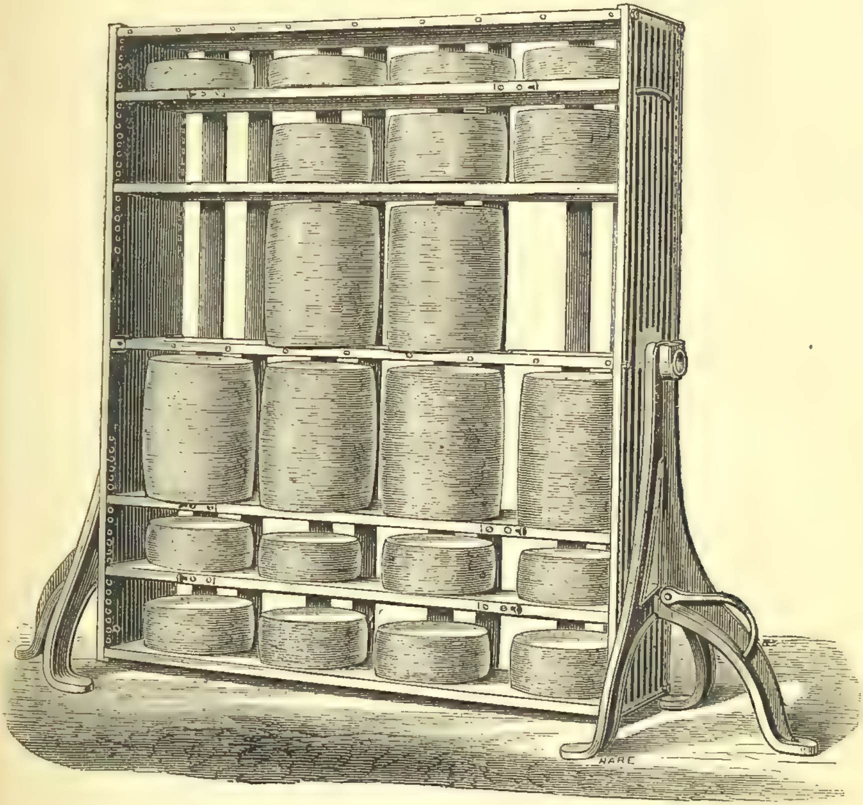

Fig. 104. Carson and Toone's Cheese-turning Apparatus.

While some persons use unsalted and undried skins in making the preparation, others use them well salted, and, to some extent, dried also. In some parts where we have seen cheese-making abroad, the skins were very dry and unsalted, and exposed for sale by the makers.

Annatto is an article likely to be long used in the dairy, both for colouring cheese and butter. When made from the genuine vegetable it is quite harmless, and it imparts no taste. Some persons consider it an adulterant, but it is used more to please the eye than to deceive.

Dairy Salt is an article which should be purchased with extreme care, for an inferior sample has a bad effect upon both butter and cheese. Those prepared by Higgins and Corbett are the best in the trade, both firms sending out special Dairy Salts.

CHAPTER XVI.

MILK FACTORIES.

SINCE the date of the chief improvements in the dairy system, and the invention of machinery, which has almost revolutionised the trade in milk and its constituents, farmers have in some countries amalgamated, in order to save the expense of individual dairies; sending their milk to one common building, where it is converted into cheese or butter. In others, again, landlords have taken up the idea in a most spirited manner, and have endeavoured to assist their tenants, and, at the same time, promote an industry which, so far as we British are concerned, has been far too much confined to foreigners. In England the introduction of the factory system is largely due to the late Lord Vernon, Mr. J. Y. Crompton, the Hon. Edward Coke, and Mr. H. M. Jenkins, whose pioneer work in Derbyshire is well known, and who deserves the thanks of the whole dairy community. In America, factories—in some instances known as creameries—have been established by enterprising tradesmen, who buy the milk of any one who likes to send it, and who make a capital thing by the business. In recently visiting Cheshire farms we were struck with the fact that, where so many cows are kept, each farmhouse has, ostensibly a dairy, but really a factory, attached to it, and that, consequently, very much money is spent for labour, which might be saved under a system of co-operation. Whether farmers would prefer the present system to that which would save them so much trouble—for they would merely deliver their milk twice daily at the factory, and keep an eye to its working, if co-operative—we do not know; but

it may readily be believed that some of them like the life they lead, and would be positively unhappy if they had a day without cheese-making in the proper season. Two of the best known English factories are the Aldford Cheese Factory, the property of the Duke of Westminster, and that belonging to Lord Vernon, at Sudbury, in Derbyshire, where butter is the principal article of manufacture. Lord Vernon was one of the most progressive and public-spirited of patrician landlords. He long connected himself with the practical side of agriculture, and more especially with dairy-farming, and has done a great deal of good in many ways. His factory is the result of a desire to see and to show what can be done. The risk was all his own, and had it proved a failure the loss would not have fallen upon his tenants in the smallest degree, for the milk is purchased from them outright. The factory is almost within a stone's throw of Sudbury station, and close to the rails, a siding running right up to it. So far it is an unpretending building; but, small as it is, it is fitted with the best machinery which science has invented and money can buy. The chief apartments are the separator-room, the churn-room, and the butter or making-up room, all of which are fitted with the best of materials, but without any pretence at display. The floors are of concrete, and as clean as water can make them. When the milk arrives it is sent up a lift to a stage at the top, upon which stands the Aylesbury Dairy Company's weighing machine, with a strainer attached. The churns are emptied, and the milk at once weighed and strained, and booked in a ledger at hand. Although the weighing machine is a good one, it may be questioned, in the first place, whether it is not too expensive for general use, and in the second, whether it is large enough for such a concern as this. At all events, factories abroad show something more sensible, and such as most practical men would prefer, were they in a position to make a choice. From the weighing machine the milk runs into a huge tank, and from this into the drums of the three Danish separators.

In a room adjoining the separator-room is the churn-room, and here are two large churns (Bradford's *Diaphragm*), which work by steam power, this being carried throughout the building. One or both churns can be worked simultaneously, and around them runs an iron rail, fitted to prevent the contact of the dress of any one passing, and to guard against accident. The churn-room is about 20 feet square; it is lofty, and a driving-shaft runs exactly over the churns. In one corner is the door from the separator-room; in another there are slate shelves, and the salt box close by; while in front of the churns is the Embree butter-worker, also driven by steam, with a butter-stool by its side. The cream is poured from large railway churns into a cream can with a strainer over it, and then into the butter churn; but a gauze strainer would be preferable to one of cloth, which necessitates the use of the hand in the cream—a practice which should be avoided. When the butter is made it is taken out with a wooden scoop, and passed through the butter-worker, the girl who manages this, building it up into a huge cone on the stool by her side, as it is finished; it is then covered with a wet cloth, and carried into the butter-room. The butter-worker is a circular inclined table, which rotates when the handle is turned, passing the butter under a fluted roller, and squeezing out the water or buttermilk without destroying the grain. All moisture at once runs away, the whole being done without the butter being once touched by the hand. If necessary, the butter can be salted on the worker with great ease. These butter-workers, as well as those of rectangular form—which are cheaper and more valuable still for private dairies—are of great service. They have often been objected to by those who are strange to them, but no one who has thoroughly tried one will deny that they are infinitely superior to hand labour. In large dairies they enable the maker to amalgamate his butter, to salt it, and to make it of one quality throughout. In working, the machine is turned slowly, and having passed through once, the attendant, with wooden

knives, turns the butter, and resets it to pass under afresh. The butter-room is a little smaller than the churn-room, and it has slate shelves fitted round it upon bricks. At the end is a desk for the clerical work in connection with the weighing and booking of the butter for customers. The large cones of butter are here weighed up into pounds and half-pounds by a woman, each roll being enveloped in a cloth, ready for packing. A man selects the boxes according to the extent of the order, lines them with paper and butter-cloth, and then the rolls are packed in, fastened down, and addressed, and sent to the station, where a number may be seen daily, dispatched to towns in all parts of the district.

A foreman lives at the place, but there is a manager, who has an office in the factory. So far things have gone on smoothly; the farmers who send the milk are satisfied, Lord Vernon is satisfied, and there is no doubt that complete success will attend the enterprise. The skim-milk is sent away for sale, or given to pigs, which have very useful styes near. Their floors are cemented, and there are sinks in the middle of the yards. The tanks, from which the food is given to the pigs, are filled from cans, which are run down on a tram carriage from the factory. So far, the pig department is a makeshift, and there is no better. When it is difficult to sell or utilise skim-milk, a pig will always pay for its use; but from what will be seen further on, we are of opinion that this milk can be utilised in a much better way, and one which will be found a benefit both to the working classes and the producer.

Since the above was written, the noble founder of the Sudbury Factory has been succeeded by the present Lord Vernon, who is carrying out the work with great spirit, and who is well seconded by his agent, Mr. Algernon Fawkes. A Dairy School, at the opening of which we were privileged to take part, has since been added, and pupils are admitted and instructed upon most advantageous terms. Many improvements have also been made in the factory.

German Factories.

The first Dairy Company in North Germany was founded in Kiel in 1877, the unceasing efforts of Dairy-Director Block having succeeded in bringing the system to life. He directed the business for a long time, and arranged and conducted the dairy factory at Magdeburg, while among others he also designed the Brunswick dairy which was founded in the summer of 1880. In the first month there were 2,000 litres of milk delivered daily, which quantity continually increased, so that in the summer of 1883 8,000 litres were reached. The building is three stories high and well provided with cellars. On the ground floor are the counting-house and board-room, shop and room for the sales-women, expedition room, butter chamber, skim-milk-room, rinsing-room, machine-room, and built on to it is the boiler-house and coal-room, to which the stables are attached. On the first floor is the centrifuge-room, the cream-room, and the butter and cheesemaking-rooms; and in the front, the dwelling of the director. On the second floor is the new-milk-room and the cheese-room, and, in the front, dwelling-rooms for some of the assistants. Eighteen of the associates (for the factory is co-operative) transmit milk, four sending it by railway (440 gallons), the others delivering it at the dairy in their vans. In summer, milk is delivered twice daily; at other times only once, except that which comes by rail, which always arrives once a day. This is unloaded at the steps and divided amongst the salesmen or brought to the lift, by which means it is raised to the second floor to the new-milk vats. The lift is closed on all sides, but has doors towards the rinsing, skim-milk, centrifuge, and milk-rooms, the cheese-factory, and the platform in front of the cheese-chamber. On this platform are the pulley and wheel for the lift. In the milk-room the milk is poured through a wire sieve into the collecting vats, which are made of tinned iron and stand in wooden basins, which are filled with water for cooling. Each of

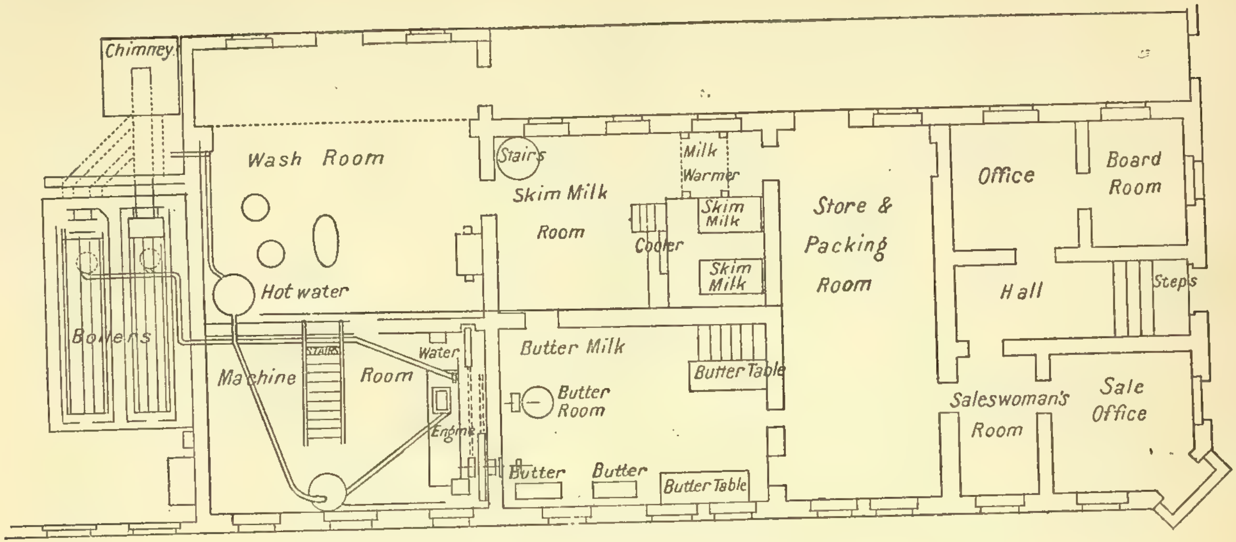

Fig. 105. Brunswick Milk Factory. Ground Floor.

these collecting vats holds 2500 litres, and from them the milk is drawn with syphons, on which tubes are fastened, these conducting it into the warmer, which is heated to 86° Fahrenheit, when it flows into the centrifugal separator. On the tube is fixed a movable dial which regulates the outflow, and an ordinary cock to stop the outflow without removing the dial. The warmer is a double vat or kettle, and the milk is warmed by steam which streams through the lining. There is also a stirrer by which the milk is agitated during the process. In the centrifuge (that of Fesca of Berlin) the cream is skimmed from 2500 litres of milk, the skim-milk which is sold containing about ·05 per cent. of fat, and that to be converted into cheese ·02 to ·03 per cent. The skim-milk to be used for cheese runs into the cheese-vat, while that for sale is warmed to 167° Fahr. It then flows out of the warmer over the milk cooler into the skim-milk vat. In winter the milk runs direct to the cooler and the warmer is not used. The cream which is to be kept for sale is also heated to 167° Fahrenheit, and cooled on the cooler in the cream-chamber. The cream which is to be converted into butter comes to the cream-chamber where it is agitated in large tubs placed in wooden reservoirs filled with water, either to warm or cool the cream. It is then churned in the butter factory in two Holstein churns of 300 litres capacity. The butter obtained comes to the butter-room, in which it is worked on the circular worker, salted, and laid in the butter-trough. The following day it is weighed for sale in the town, in quantities of ¼ and ⅛ of a kilogramme, and made into shape, and stamped with the mark of the factory, a portion being sent in tubs and barrels to other places; while in winter it goes to Hamburg, and thence to England. A steam-engine of twelve-horse power drives all the machines. The water is only 48° Fahrenheit, so that it is used for cooling. It flows out of the reservoirs, through pipes, into all the rooms of the factory. The rising steam goes from the machine through the warmer to the water-butt in the rinsing-room, and there warms the necessary rinsing water.

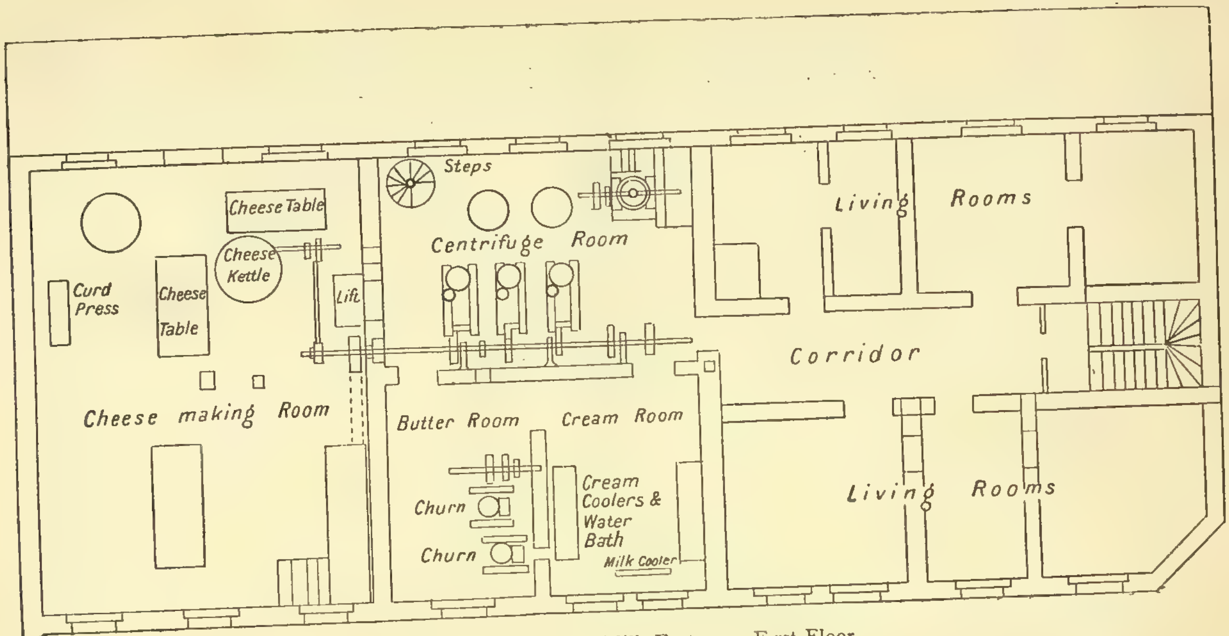

Fig. 106. Brunswick Milk Factory. First Floor.

Steam-pipes are conducted through all the rooms for warming, evaporating, and heating purposes. The cleansing of the selling

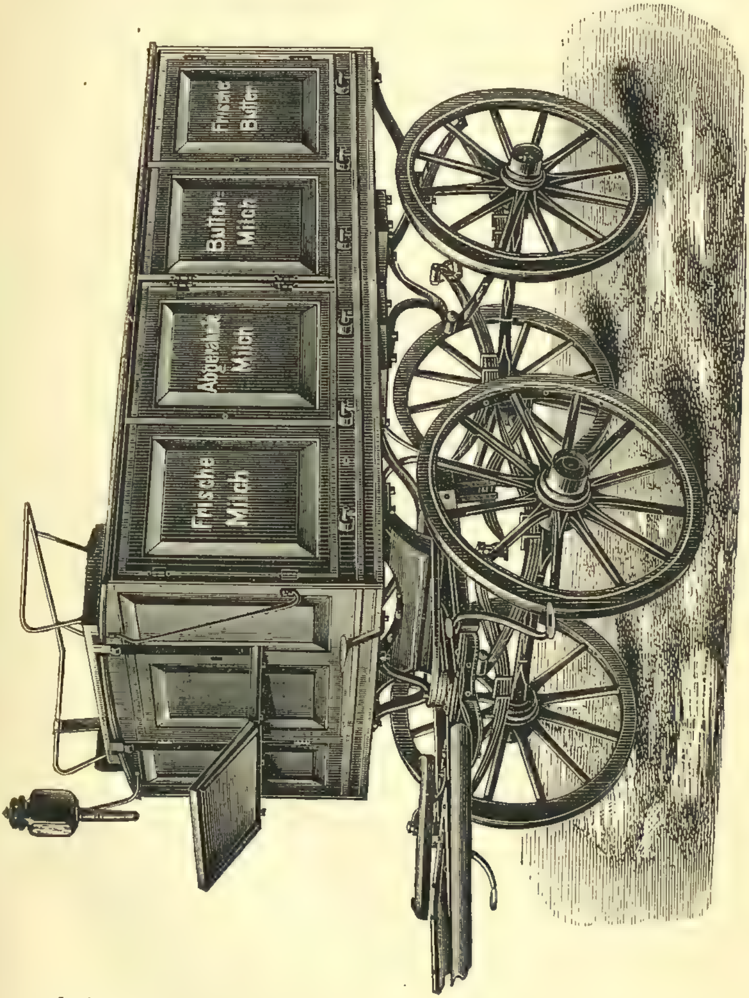

Fig. 107. German Lock-up Milk Van, showing Taps of the Milk Cans within.

and delivering cans is done in the rinsing-room, and generally, after washing, the vessels are again cleansed on a self-constructed

rack, with combined steam and water-pipes. The sale in the town is carried on by means of five vans and three hand-carts, the vans, which are drawn by one horse, each containing twelve cans of 50 litres contents, and two of 30 litres, so that one fully-loaded van carries 660 litres of milk. The vans are closed in on each side, and locked, so that milk and cream cannot be adulterated (Fig. 107), and the taps of the selling cans are alone seen. In the middle of the van, from back to front, lie long drawers which are drawn out over rollers through a door at the back. In these is the butter, each pat being on a piece of parchment paper. The sellers also take cheese with them in tinned boxes. The hand-barrows carry four cans of 50 litres each, and one of 5 litres for cream. One van goes daily to a neighbouring town. There is a shop in the factory, and another in the city of Brunswick, while butter in kilogrammes and half-kilogrammes is sold by several provision merchants. The skim-milk which is not sold is almost exclusively worked into Backstein or Limburg cheese, 100 litres furnishing about 8 kilos., its value being about 20*s.* to 24*s.* per cwt. The cheese is sent away in boxes of 30 kilos. net, without reckoning the box. A portion of the buttermilk is turned into sour curds and worked into hand cheese. One hundred litres of skim-milk give 10 kilos. of curds at 20 pfennings per kilo. (1¼*d.* per pound), and the curd remaining 2 pfennings. The advantage of the factory being built on three storeys, is that all milk runs from one vat or apparatus to the other. Nevertheless it has its disadvantage, inasmuch as the control over the working is somewhat difficult. The waste, such as whey and a part of the buttermilk, is used as food for pigs, the young pigs being bought at three months, and fed until they are six months old, getting for the last few weeks about one kilogramme of meal daily in addition to the milk. They weigh about 100 kilos. when sold, and go to buyers for further fattening. A part of the buttermilk is given to the horses, *i.e.*, 6 to 10 litres a day, upon which they thrive well, and

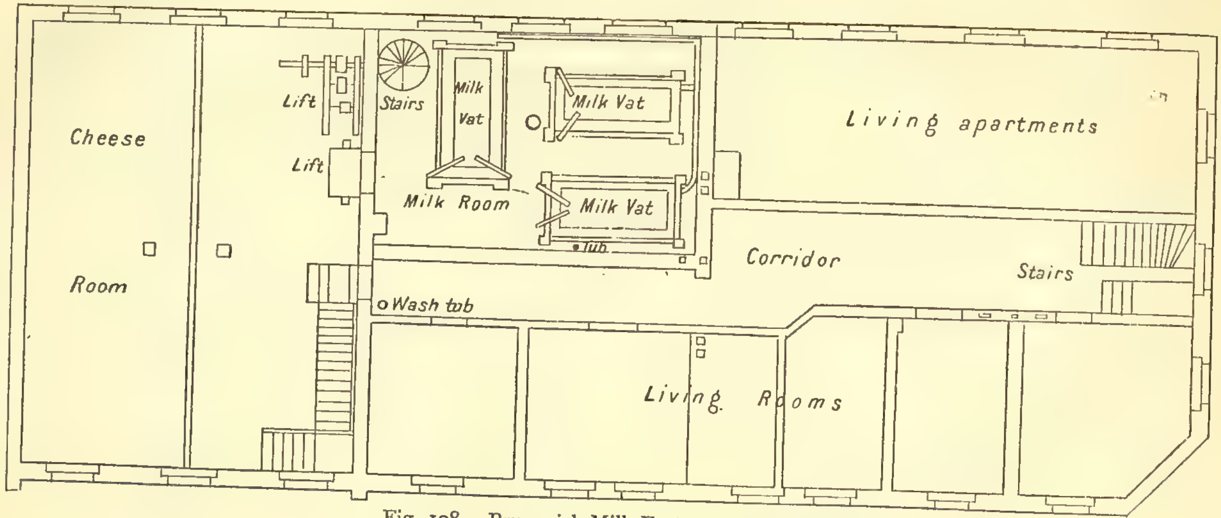

Fig. 108. Brunswick Milk Factory. Second Floor.

consequently materially reduce the cost of corn. After the cheeses have been prepared and formed in the cheese factory, they are taken into the cellars for ripening.

The cost of this factory, together with the land upon which it stands, and the machinery, was about £10,000. It is in the suburbs of the city, and is thus enabled to do a lucrative retail trade. The butter is sold at 3*s.* the kilogramme, coffee-cream, as it is called, at 1*s.* the litre, and thick cream at 1*s.* 6*d.*, there being two qualities, as in some parts of London. New milk sells at 8*d.*, skim-milk at 3½*d.*, and buttermilk at 5*d.* the gallon, the retail price of the Limburg cheeses being, for those of ¾ lb. weight, 3*d.* These are made at the rate of 16 lbs. per 100 litres of milk, so that, reckoning the milk at 3*d.* a gallon, as in England, or 5*s.* 6*d.* the 100 litres, they would cost when ripe about 4*d.* per lb. with us. In the year 1881–2 the milk yielded 2·76 of butter and 15 per cent. of cream; while in 1882–3 the cream was reduced to 13 per cent. and the butter to 2·61. In that year 2,000,000 litres of milk were delivered, and of this quantity some 600,000 odd litres were sold fresh, the remainder (minus 2 per cent. lost in measure and waste) being passed through the centrifugal machines and creamed, the cream realised being 200,000 litres, of which 3,000 were sold and the rest churned. The skim-milk measured 1,300,000 litres, 650,000 of this quantity being sold, and the rest converted into cheese. There were 170,000 litres of buttermilk, of which 17,000 were sold, 120,000 used for feeding horses and pigs, and the remainder made into cheese. The cheeses made numbered 130,000, and these resulted from 700,000 litres of skim and buttermilk. The milk is periodically examined and kept remarkably pure by the exertions of the chemist appointed for the purpose. The concern has been worked so successfully that there are a number of farmers waiting to become members; but at the present time the business cannot be extended in consequence of the plant not being sufficiently large to deal with more milk, so that those

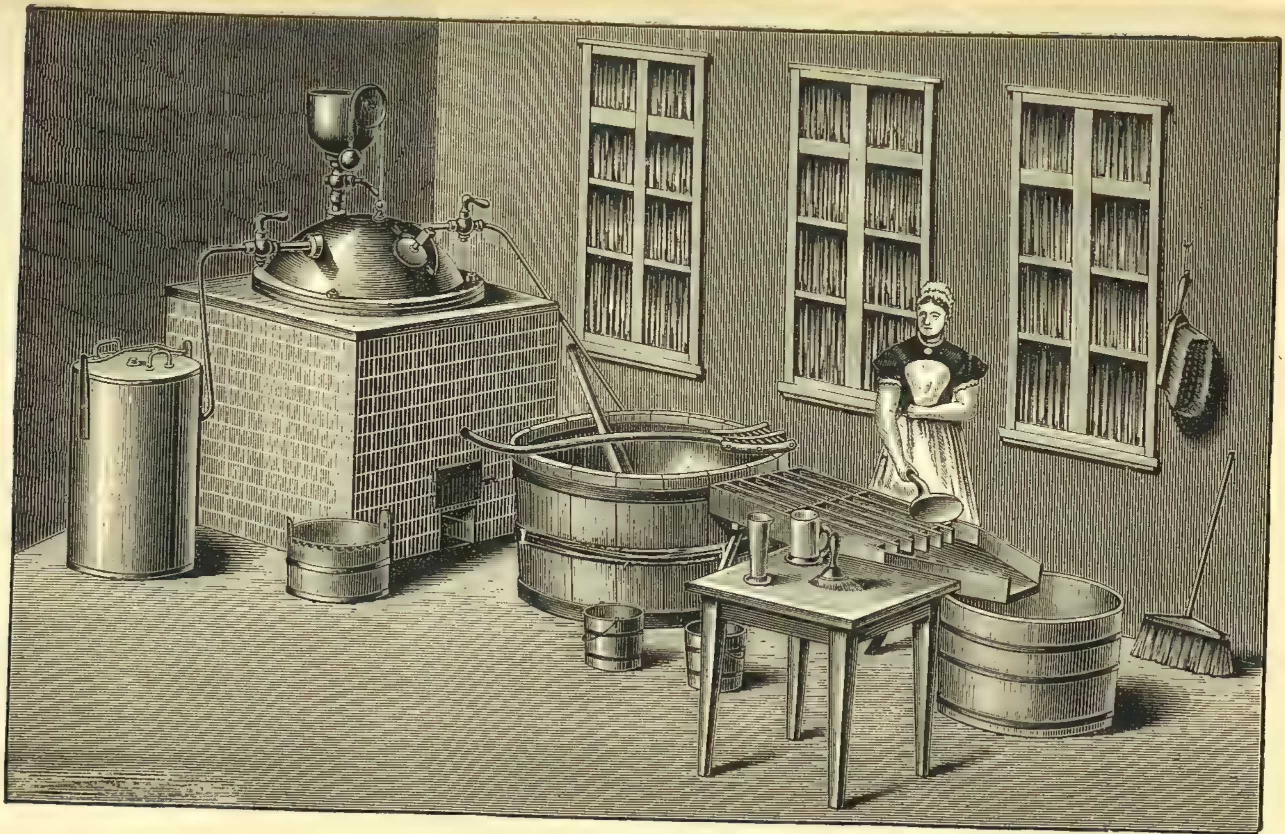

Fig. 109. Limburg Cheese-making.

farmers who had the good fortune to start the factory have to congratulate themselves upon a very lucrative position. The quantity of milk delivered to the factory was the greatest in the months of May and June, when 250,000 litres were delivered; but this fell to 140,000 in the month of September. Limburg cheeses were made more largely in April and May than in any other months; but the largest sales were in March, when they reached 25,000, the sales of other cheeses being then not so great. The sale of new milk was largest in the months of June and July, and of skim-milk in May and June. Strange as it may appear, and this will be instructive to the general public, there was a loss in weight for the year of butter of 722 kilogrammes; of cream, 83 litres; new milk, 18,000 litres; skim-milk, 19,000 litres; and of buttermilk, 2,500 litres. The whole concern does great credit to Mr. Hirschfeldt, the manager of the factory, to whom we are indebted for many of the above particulars, and for his courtesy upon our visit; and it reminds us of the fact that North Germany is extending this most successful system just as America commenced to extend it ten years ago.

A Berlin Factory.

We have also received a few interesting particulars with regard to the gigantic factory in Berlin owned by Bolle & Co., which we visited in a subsequent year, and where 80 vans are employed in the distribution of the produce. The new milk costs 6*d.* a gallon, and sells at 10½*d.* retail; so that Berlin is better off than London. The skim-milk, however, sells at the remarkable price of 3½*d.*—at all events remarkable when compared with the price of new milk—and buttermilk at 5*d.*, the latter of which many people in England will not have at a gift. Backstein cheese, similar to Limburg, is made, 650 litres making a hundredweight, or about 8 per cent., and selling at from 13 to 27 marks, according to the season of the year, and whether sold new or ripe. The

butter sells at 1*s.* 7½*d.* a pound, first quality; and second and third qualities (in other words, second and third returns) at lower rates. The centrifugal machines leave only from 0·3 to 0·5 per cent. of fat in the skim-milk. In the best milk the proprietor states that the butter-fat reaches 7 per cent., which it must be confessed many will credit with difficulty. Thirty thousand litres of milk are received at this factory every day.

In making the Limburg cheese the milk is placed in a large double-lined tub, which is heated by hot water when it is intended for curd. The usual plan is to heat 900 quarts to 32° Centigrade, 15 grammes of rennet being added for every 100 litres, and then 3 grammes of annatto. It is then covered for half-an-hour, and is considered ready when it breaks. It is next cut up in the usual way, drained, and placed in the little 4-inch square moulds, which are full of holes for the escape of the whey. Each cheese is salted top and bottom four times, once a day for four days, and then put aside to dry. It is not turned, but is examined two or three times during the two or three weeks it remains, when it is sold and consumed. The drying compartment is a dark cellar, similar in temperature to the French *cave*.

A Scotch Factory.

About half a mile from Dunragit railway-station, upon the sloping bank of the Darjeeling Burn, in Wigtownshire, are situated the buildings of the Creamery Company's butter and cheese factory, this being the first factory of the kind in Scotland. These buildings are some thirty years old, and were at one time used for the manufacture of farina; that enterprise however resulted in failure, and they were left standing empty until reconstructed and fitted with the most approved appliances for butter and cheese making. The milk, as it arrives in the long-shaped cans, is hoisted by a light crane to the upper flat of the building, where the receiving office is situated, and it is there emptied into a large tub placed

upon a weighing-machine. It is weighed, not measured, and then run off from this tub, by means of a pipe, into one or other of two large vats placed somewhat lower down. It is conducted again by means of pipes from these vats to the room below, where it is passed into a small square tub with double bottom and sides, formed in the same way as the double-bottomed cheese-tub; and by means of steam the temperature is raised to 75° Fahrenheit. From this warmer it flows into the centrifugal separator. When the cream vat is full it is connected with the churns, which are situated on a lower flat, and the cream is then run through pipes into each. There are two churns, one a large Ayrshire, capable of holding 300 gallons of milk, the other a Danish, which holds 50 gallons. The work of turning these large quantities of cream into butter occupies on an average about forty-five minutes. The whole process of handling both the milk and the butter is marked by the most scrupulous regard for cleanliness. It is only in this way that butter of the first quality can be produced, and this company relies upon its success in the production of an article that will top the market wherever it is sent. The Danes have long been famous for their butter, and a skilled Danish expert is employed here to make it. After the butter is taken from the churn it is transferred to a wooden trough in an adjoining room, where it is handled slightly and then put upon the butter-worker, a circular marble stand with marble rollers, by which the milk is worked carefully out of the butter. On the ground both of cleanliness and expedition, this method is considered preferable to working it with the hand, and is also in every respect a more efficient way of taking the milk out of the butter. Before being removed from the worker the butter is slightly salted, and it is then put up in little tubs, and is ready for the market. Part of the skimmed milk is sent on to Glasgow to be disposed of in the ordinary way. The remainder is mixed with the buttermilk, and made into cheese, for cheese-making, indeed, promises to be as much a feature of the work carried on

here as the butter-making. A special department is fitted up for that purpose, and one of the best cheese-makers in the country, Mr. M'Adam, has been engaged to take charge of it. The cheese made here from skimmed milk is a good wholesome article, superior to most of the American cheese, and the company can afford to sell it at a price much less than that paid for Cheddar. The newest thing in the cheese-room is a horizontal American cheese-press, which presses at the same time from one cheese up to a dozen. The whey and other refuse from the dairy is carried in pipes about 400 or 500 yards down the glen and under the railway, to a field where the piggeries are situated.

The regard for cleanliness, which we have already noticed, dictated the erection of these at this distance, so that at no time would any odour from the pigs reach the butter-making rooms. A bad smell, as is well known, flavours butter very readily. The factory has an excellent supply of pure cold water. A 12-horse power engine drives the machinery. In December, 1882, the company were using the milk of about 1000 cows; they have, however, appliances sufficient to work three times that quantity; and, from the favour the prices they give for milk is meeting with in the district, it seems likely that they will soon be at their utmost limit. Steps have been proposed to be taken in the parishes of Kirkmaden and Stoneykirk, which are denied railway facilities, for organising a convoy of waggons to take the milk to the factory, during the winter months at least, instead of each farmer sending his own cart.

Canadian Factories.

Within an easy distance of Lancaster, Ontario, there are some 80 cheese factories, more than one-third of which are under the control of Mr. M'Pherson, the cheese-king of Canada. Besides Mr. M'Pherson, there are three other large operators, who own 22, 10, and 6 factories respectively. Mr. M'Pherson's factories

are of a moderate size, compact and inexpensive, but durable and neat. Some of them receive the milk of 200, others of 700 cows, and the total number of cheeses made per day in all of them together in July, 1882, was 400, averaging 66 lb. each, all of first-class quality, and commanding top price, which was in the same month about 5½*d.* As far as it is possible for the superintendent of so many establishments to personally control the mode of manufacture, the factories all work on the same principle, which is the following: The deliveries of milk are made only once a day, and it is required to be sweet and clean. It is warmed to 84° Fahrenheit (or, if advanced towards souring, to 88° Fahrenheit) by means of steam contained in a single straight pipe beneath the milk vat, which is made of zinc, and placed in a wooden tub; sufficient room being left between zinc and wood to allow of the infusion of steam, which is discharged through holes in the pipe. The jets of steam are directed horizontally against the sides of the wooden tub, and are thus broken, by which arrangement the steam spreads evenly over the sides and bottom of the zinc vat, and heats it much more quickly than if water were used. The rennet, Hansen's Extract, causes coagulation in 45 minutes. The curd is then cut into ½-inch cubes, and the whey allowed to drain off. The cubes of curd are next stirred to keep them from adhering together, and their temperature is raised to blood heat. As soon as they are hard enough, one end of the vat is tipped down, and the whey, while yet sweet, is drawn off through a strainer and tap. Meanwhile, and for some 15 minutes afterwards, the cubes are stirred for the purpose of airing and assisting the whey to run off, which is considered to be of great importance. The mass is then hauled to the sides of the vats and left to settle. When dry enough to hold together, it is cut up and turned several times to set free the remainder of the whey, for which about a full hour is required. It is then passed through the mill and salted in proportion of 3½ oz. of salt to 100 lbs. of milk, after which it is placed in the cheese vat and stirred, to

admit as much air as possible, and finally it is pressed. It is well known that Mr. M'Pherson has devoted much study to the various methods of cheese-making. He first used to subject the curds to souring before draining off the whey—what is called the "acid process"—but afterwards this system was changed for the Cheddar one, *i.e.*, draining off the whey sweet and allowing the curd to settle in one mass, leaving it in the cheese vat till sufficiently ripened, and then grinding and salting it. Recently he has adopted the plan of airing the curds after cutting them up, whereby they become oxidised. This being a very important feature of the manufacture, it is further assisted by grinding it a much longer time than is generally done; while, on the other hand, time is gained, as compared with the Cheddar system, by not allowing the mass to settle in a state of compactness, but by stirring it and keeping it fine. The greatest care is taken to prevent the loss of white whey, in order to ensure the richest and finest quality as well as the greatest yield. Mr. M'Pherson uses no curd sinks, but utilises the milk vats for the entire process, thereby saving the outlay for sinks and the room they would take up. The steamers are so placed as to warm the making-rooms merely by the heat radiating from them, and like all the other appliances, they are easily kept in a state of efficiency and cleanliness, being, nevertheless, low in price. The factories are visited at irregular intervals by an expert, who tests the quality of the milk by means of graduated tubes and ice-water—a process which occupies six hours. The seamless bandages used to encase the cheeses are supplied to the factories cut off at the proper length and ready for use.

Dutch Factories.

The principal dairy factory in Holland is to be found at Leyden. In 1879, the manager received 1300 gallons daily, representing the produce of some 500 cows. The price was then about 5½*d.* per gallon; a small quantity being sold in the town

at 8*d.* per gallon, delivered at the houses. The bulk of the milk is made into butter and lean cheese; but the purveyors of the milk have the right to purchase their skim-milk at the rate of ½*d.* per gallon. The milk yielded 3 per cent. of its weight of butter, and 7 per cent. of lean cheese, the former being sold at 1*s.* 4*d.* per lb., and the latter at 4¼*d.* per lb.

Another butter and cheese factory was established about the year 1879, at Tochthuis, near Hoorn, North Holland. The milk is bought from the surrounding farmers at 5½*d.* per gallon. In summer time the water at their command was not cold enough to enable the manager to carry out the Swartz system in its entirety, and he therefore substituted flat pans immersed in the water. Skim-cheese is made in the Edam shape, and sold at 60*s.* per cwt. All the best Danish and German dairy utensils are in use, except false-bottomed cheese-tubs. The establishment of this factory by small proprietor farmers is a distinct proof of the desire existing in that part of the country to take advantage of any improvement in dairy practice.

The province of North Holland possesses also a Co-operative Cheese Factory at Winkel. The joint-stock company to which it belongs is called the "Wieringer waarder [Maatschappy tot bereiding van Kaas." It receives the milk of about 160 cows from eight contributors, who skim the evening's milk in the morning, and mix it with the unskimmed morning's milk, sending the mixture to the factory, where it is made into Edam-shaped cheese, selling at 50*s.* per cwt., or 5*d.* per gallon of milk. Cheese is made twice a day, in vats of the square American pattern. The domestic regulations of this company are as follows: Art. 1. The members shall supply to the manufactory pure, unadulterated unskimmed, sweet milk, provided that it is exclusively from their own cattle, at 5*d.* per gallon. No milk must be supplied except from cows which have calved at least three days previously. Art. 2. The milk must be delivered at the hours to be fixed by the secretary, and to be made known to the parties concerned.

Milk arriving too late may be refused. Proof shall always be given of the weight of the milk delivered. Art. 3. The milk shall be paid for on Saturday evenings at the office of the manufactory, in this manner: at the end of the first quarter 5 cents. per kilo shall be paid to the contributors, and afterwards every fortnight an instalment of 3 cents. per kilo, &c. Art. 4. Should it appear that the milk supplied to the manufactory is not in accordance with the quality and conditions mentioned in Art. 1, or that the casks are not clean, or that other faults exist, the guilty party will immediately be warned, and in case of repetition the milk may be refused. Art. 5. Any one supplying milk, whether a member or not, can, at a price to be determined by the direction, purchase whey in proportion to the milk supplied by him. The direction shall use the remaining whey to the most profitable purpose. Art. 6. No one, the members excepted, shall have access to the factory. Art. 7. The milk must be delivered by boat, or by carriage on springs. Art. 8. In January, every year, a meeting of members shall be held.

A Cheshire Factory.

In August, 1882, we paid a visit to the factory of the Duke of Westminster, at Aldford, which is an unpretending building, and is managed by a committee, under whom is a foreman. This man, with a dairymaid, gets through almost all the work. In May and June, about 23 cheeses a day were made, this number falling to 17 in August; but they are not of so large a size as those made at the farms. In some instances Cheshires are made, in others cheeses of the Derby shape, which are about 15 inches across and much thinner. Why this is the practice we cannot understand, as the latter do not make so much money as the former. In May and June the milk received is about 600 gallons a day, and at that period about 8 lbs. of butter is made daily from the whey top. This does not appear

exorbitant when we compare it with the farm practice, but here no cream whatever is taken from the milk, although at most farms there is no attempt to deny that a little is taken from the night's milk. As a matter of fact it would be impossible to skim much from one night's standing. The whey is given to the pigs as a rule, and is pumped to the piggeries by a convenient system. Although the milk was not so large in quantity in August, it was improving in quality, and, whereas in early summer it takes 10 lbs. to make 11 lbs. of curd, 9 lbs. then suffice. The milk-room is a spacious apartment, measuring about 65 or 70 feet by 35 feet. It has 3 huge vats, which are similar to Cluett's and are heated by steam. Over each vat is an ingenious steam agitator, which is set to work when the night's milk is poured in, so that the cream may not rise. This device is worth notice at the hands of all cheese-makers, although it may be met with the reply that, inasmuch as they take the cream and get as much money for their cheese as the factory, the arrangement is not needed. An iron shaft runs along the ceiling, and from it is suspended an iron rod, at the bottom of which is a cross piece; attached to this are the agitators, which continue to move through the milk in the vats during the night. In mixing the rennet, which is home-made, one pint is used to 1000 lbs. of milk. We question whether privately-made rennet is so equal as that which is prepared, although it may perhaps be cheaper. The cheese-presses are of both the old and the modern type, at which we were somewhat surprised; but there are still many who consider it a sin to use modern appliances, however good, while they can buy old ones at sales, as is often done, at a much lower price. A churn, one of Hathaway's barrels, is connected with steam-power, but we missed the butter-making arrangements so perfect in Lord Vernon's factory. The cheese-room is about 60 feet by 30 feet, and it contained, when we visited the factory, some hundreds of thick and thin cheeses. Here shelves are used in four rows of six tiers each. The bottom tier is 2 feet off the

ground, and the cheeses stand 18 inches apart. When cheese is sold, the committee meets the factor and bargains, just as a factor and a farmer, although perhaps not so quickly; but there can be little question as to the advantage of the arrangement. There are other cheese-rooms overhead, which are reached by the lift we have before referred to. The piggeries are some little distance from the factory, and rightly so, and they are kept in two huge yards, with open styes, the floors being bricked. At the date of our visit one side contained 20, and the other 25 pigs. Stone basins open through the wall and shoot the whey, which is run from taps into the stone troughs within. Each trough is covered with a stone coping about 2½ feet high. Our remarks upon the factory system, as exemplified in the Duke's factory, need be few. We do not know what the farmers receive, but where a couple of hands can manipulate the milk of 200 cows, in round numbers, as is here done, there must be something good in the system. Four fair-sized farms with 50 cows each would in each case employ this labour, whereas if the milk is sent away twice each day it seems to us that the farmer saves time and expense, and can devote himself to other duties. A farmers' factory upon this basis would be a co-operative affair, in which, while realising the same price, there would be a lessening of the expenses.

Since writing the above we have learned that during the past year the average price of cheese was 68*s.* per cwt., the members obtaining 6½*d.* a gallon for their milk after expenses of manufacture were deducted—the wages amounting to 3*s.* 2½*d.* per cwt. There is in favour of the factory system the saving of extra labour to the farmer, and the drudgery to his wife and daughters; on the other hand he undoubtedly makes a better price of his milk by making cheese at home.

A Gloucestershire Factory.

In April, 1883, a new dairy factory was opened near the town of Berkeley, in Gloucestershire. The buildings were designed

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and fitted by Messrs. R. A. Lister & Co., of Dursley, and, in all, about £4000 have been spent on the factory. It is let by Lord Fitzhardinge to the Berkeley Vale Shorthorn Dairy Company, Limited, which works with a capital of £10,000. The main building, which closely adjoins the Berkeley railway-station, is a square block, 72 feet long by 40 feet wide, and two storeys high. The bottom story is divided into two compartments—one for the

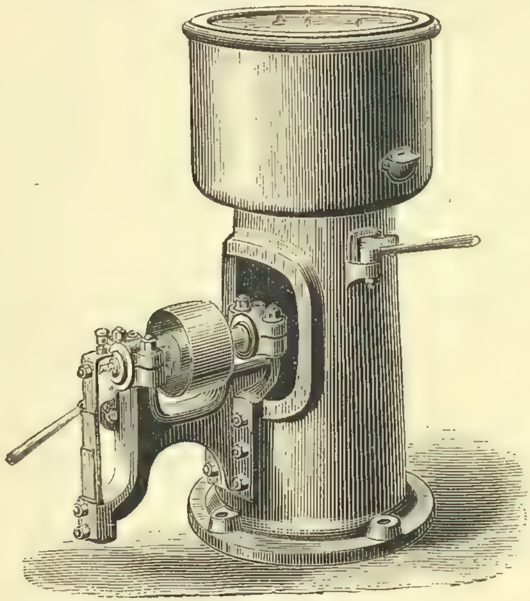


Fig. 110. Pilter's Délaiteuse.

manufacture of butter, and the other of cheese. The second storey is one large room, used for the storing of cheese and butter, although the latter article is in hot weather stored in an iced cellar. The receiving platform for the milk is at the rear of the factory, and is fitted at one end with a large receiving tank, into which the milk is put after it has been examined and the quantity checked. From this tank it flows into Danish and Laval cream separators, the cream being next transferred to the two barrel churns. When the

butter has come it is taken to Pilter's Délaiteuse for the extraction of the buttermilk, and then to the butter-maker, on which it is well kneaded. After all the buttermilk has been pressed out of it, it is made into rolls upon marble slabs with wooden implements, not being touched by the hand during any part of the process of manufacture. The cheese-making compartment is also connected with the milk-receiving tank by means of a tube, and it is fitted with the best appliances that money can buy. When the cheese is ready it is taken up into the store-room above by means of a lift. The surplus skim-milk is made into lean cheese, but the bulk of it is sold to bakers, confectioners, hospitals, &c. It has been a great objection against the factory system, that farmers lose their whey, but the Berkeley Company allow their customers to purchase the whey of their milk at ½*d.* per gallon; it is taken out of the tank by means of a chain pump. In order to prevent the smell of the piggeries reaching the factory, the former have been constructed at some distance on the opposite side of the road. The styes are fitted with oak-sparred floors for the animals to lie upon, and are altogether of the most approved style. They are arranged in two rows, and will accommodate some 350 pigs. The whey tank, which will hold 10,000 gallons, is in direct communication with the troughs. Close to the receiving platform is the engine-house, which contains one of Ransome's semi-locomotives of 8-horse power, which works the machinery of the butter and cheese departments. The boiler is of 10-horse power, and fitted with 42 tubes. The spring water out of the well is also raised by steam. There are numerous farms on the Berkeley estate, and it is expected that, as their London contracts cease, they will take their milk to the factory. A large London hotel has contracted with the company for a supply of butter, to be delivered free, at 1*s.* 5*d.* in summer and 1*s.* 7*d.* in winter.

A Cumberland Factory.

Carrick's Cumberland Dairy at Low Row was established in 1881. Low Row, some 50 miles westward of Newcastle, is situated at an elevation considerably above the level of the sea, and the air there is always pure and in summer also cool; at least much less warm than in the valleys, which is a great advantage in the manufacture of butter and cheese. The factory is supplied with water from a spring which rises amongst the hills half a mile distant. It is exceedingly pure, and has a temperature of 47° Fahrenheit in summer. At the back of the factory is an underground storage reservoir, holding 17,000 gallons. The premises are laid out on a plan similar to that of the Aylesbury Dairy Company. Absolute cleanliness is insisted upon in regard to every process conducted in the factory, and everybody concerned in the manufacturing departments puts on a clean linen suit every day. The piggery is constructed on a steep slope, at a distance of about 100 yards from the main building. The Company purchases its milk from the farmers of Cumberland, Northumberland, and the south-western districts of Scotland. They invite contracts from farmers willing to sell their milk at 8*d.* per gallon (price in 1881), provided that it is pure. Both the Swartz system of cream-setting and that of removing the cream by the centrifugal machine are carried on in ordinary times. The milk is run through two pipes from the receiving tank into the two Laval separators, which are driven by steam, and do their work admirably. From the separators the cream is transferred to the five churns situated on the other side of the room. One of the churns is a large Thomas and Taylor's *Patent Eccentric*, and it will treat enough cream at one working to produce 100 lbs. of butter, whilst the others turn out 70 lbs. at each spell of work, which lasts from 45 to 60 minutes. All the churns are worked by steam. Although cream of a high temperature can be turned into butter quicker than cream of a low temperature, it is considered injudicious to raise the tempera-

ture for the sake of hastening the process. The butter is salted by means of brine put into the churn as soon as the butter has come, and when ready it is scooped out with little shovels and placed upon the butter-worker, which is worked by steam under the direction of two men. Some 1500 gallons of skim-milk are made per diem; it is perfectly sweet, and is a cheap, wholesome food. Mr. Stephenson, the manager, forwards large quantities each day to Carlisle, Newcastle, and other towns, but it is, as yet, comparatively new to the market, and sometimes only half the quantity produced can be sold, which necessitates cheese-making and pig-keeping. With regard to the Swartz system of setting the milk in deep tins immersed in water of 49° Fahrenheit, we understand that the manager is disposed to discontinue it, as it causes a delay of some twelve hours before the cream can be skimmed off.

A Swiss Factory.

We need not describe at length the factory at Cham, which we have referred to elsewhere. The machinery is of the most perfect kind, cheese and butter being largely produced together with ice, which is used for the preservation of the butter. Here butter and cheese are sold upon a very large scale, and yet the management have a little retail shop where as little as half-a-pound can be purchased. The Lefeldt separator is used, and by this means butter is made the same morning of milking, and consumed in a large city many miles off upon the same day. The churning and butter-working are managed by steam, the churn being a huge square Blanchard, bringing the butter in 40 minutes and capable of making an enormous quantity. Gruyère and Emmenthaler cheeses are made, and the cheese-room, filled with shelves, usually contains a splendid collection of these well-known cheeses. The piggeries are commodious, and at the time of our visit contained about 200 fatting pigs, 5 or 6 being allowed in each stye, all of which are covered. The floors are sloping, and can be washed

down with jets of water in a few minutes. Both floors and troughs are of cement, and the latter can be filled from the outside; skim-milk and the offal from the condensed milk factory being their entire food.

At Cham Factory there are rooms provided for keeping the cheese at different temperatures, and this is very important with Gruyères, which readily spoil if exposed to too heated an atmosphere. About 3000 are made in the year, and, during our visit in September, one was weighed in our presence reaching 100 lbs., and numbered 2180; so that we may assume the factory makes about 135 tons per annum. The inferior cheeses are retailed at from 4*d.* to 7*d.* the half kilogramme—about a pound; boiled butter making 2*s.* 2*d.* the kilo., and fresh 2*s.* 4½*d.*, or less than at the shops—a decidedly low price. The skimmed or separated milk made 8 centimes the litre, or under 1*d.* a quart, while the buttermilk made a halfpenny the litre. Whey is transformed into rennet, and the whey used for butter-making is immediately boiled, the fat which rises in the form of scum being taken off and placed in a cool tank, where it thickens and soon becomes fit for churning. The average quantity of butter obtained is 4 per cent. of the milk. We were informed that the mixed milk averages about 14 per cent. of cream; the six days previous to our visit showing 15, 13, 13, 15, 15, and 14, the fat being in each case 3½, while the average of four months gave cream 12½, 12, 13, and 15, and fat 3½, 3⅓, 3·32, and 3·33 per cent.

CHAPTER XVII.

A DAIRY FARM.

THE writer has several times been asked by persons interested in dairy-farming, to give a sketch of the probable returns of a farm of a certain size, showing the expenditure, outlay of capital, and so on. It must be palpable that a plan of any kind, when referring to a fluctuating business, can do nothing more than give an approximate idea of its results, and especially is this the case with a dairy farm, for no two men hold identical ideas upon the management of their stock; no two herds are alike in their yield; no two farms are alike in any respect. If, then, we presume to draw an outline, which may be considered too sanguine on the one hand, or too unfavourable on the other, we must ask men of experience to remember that there are scores of farmers who, fortunately or unfortunately, are living proofs that we might have gone further on either side without erring, and who can bear out our statement that we have selected a medium course in what we have to say.

It must be borne in mind that the depression which exists in connection with agriculture has extended in a great measure to dairy-farming, and that he who makes up his mind to take it up as a business must prepare to devote himself completely to it. He must determine to work himself, to expend continuous thought upon his system, and to meet misfortunes and disappointments, and then he will not succeed in doing well unless he knows his business, is always at the helm, and brings an in-

telligence to bear upon it which is superior to that of the ordinary type of cowkeeper, who brings any kind of animal into his dairy so long as she resembles a cow and gives milk, and feeds her upon anything which hunger induces her to eat.

When a man determines to take a farm for dairy-keeping pure and simple, he should thoroughly investigate the subject, so as to enable him to understand how to obtain the largest return. He will find that there are cows which give quality, and others which give quantity of milk; that there are soils which do the same, and that there are methods of feeding which very materially affect his milk, not only making it richer and more plentiful, but altering the relative quantities of its constituents, and thus rendering it more suitable for cheese-making or butter-making. As in agriculture, so it is in the dairy, Science has done so very much, and places so much power in the hands of a man, that he can command results utterly undreamt of by our forefathers; hence it were foolish indeed of him not to master his subject and learn as much about it as he possibly can. The man who will surely succeed is he who is not only practically conversant with everything connected with dairy stock, but who has a broad knowledge of the scientific side of the question, and an energy of mind which will enable him to advance in untrodden fields when he finds he has no preceptor. Old Markham, who wrote upon the Dairy in the time of the Commonwealth, speaks of a cow giving 2 gallons a day as something extraordinary. What would he think of an animal giving 6 to 7 gallons—and there are such—or the cow belonging to a London dairyman, which averaged 17 quarts for a whole year? To whom then do we owe this great advance? Certainly not to nature, for a greater advance must have been made since Markham's time, 220 years ago, than in all the years since the creation of the world. It is owing to the perseverance and ability of men who have had a love for the subject, and who have, one after another, continued to improve the various breeds of cattle, until we find them what they are to-day—highly

creditable to our nation, but still imperfect, and capable of much greater improvement.

A dairy farm sometimes pays very well on clay, but if we had any option in the matter we should not select heavy land, because young stock do not grow so well upon it (and we think a dairy-farmer should breed his own), nor is the feed so good, especially in wet seasons. At all events we should certainly look for a farm in which at least 30 acres out of the 100 were arable, and upon this we would grow roots, artificial grasses such as lucerne, vetches, rye grass, maize, comfrey, and straw. The last some persons are able to buy so cheap that it would be folly to grow it, but as a general rule it may be supposed that oats and barley are necessaries, useful in their ground state for both cows and pigs, and as the straw is a useful food they might be grown in quantities sufficient for home consumption. Peas too will answer very well, the meal being largely used for cows, and its value every year more and more appreciated. It need hardly be stated that the farm should be drained, and in good heart. The fewer hedges the better, and if every field were divided by iron railings a large amount of labour would be saved, besides which more land would be available for culture, and vermin would be at a discount. In taking a farm great care must be used in the examination of the lease, or covenants may be inserted of an arbitrary nature, which will be equivalent to so much more rent. The great point should be to start well, and the buildings should consequently be in thorough order; but if work is to be done, care should be taken that it is not scamped, as is too often the case. Sound and convenient buildings, complete drainage, a fair lease, and a fair rent, then there is every chance of a good result. As dairy-farming is high farming, and so much money is put into the soil, a fair portion of which the tenant should receive on his term expiring, every effort should be made to obtain an equitable lease, and one which gives a tenant liberty of action. He should, moreover, refuse to be bound by any system of cropping, and claim to

sell anything off the farm so long as he farms in a proper manner. We have known farms, such as would suit the dairyman, let at 25*s.* to 30*s.* the acre. Suppose that we assume a rent of £150 for the 100 acres, with a charge of £30 for rates and taxes. The labour bill ought not to cost more than £180, that is 3 men and a boy upon regular work, and the balance for harvest and hay-making wages and an occasional second boy. To this must be added blacksmiths' and other tradesmen's bills, say £15, insurance, seeds, thrashing, grinding, wear and tear, cake and other food purchased, and minor expenses, £80—in all, an expenditure of £455.

We now come to the question of the stock; and in the first place, we would point out the necessity of beginning with the right sort only—better by far to wait until they could be obtained than purchase inferior milkers. We would see, first of all, that they were young and of a stock which had been carefully bred for the dairy. Animals such as the late Mr. Carrington had at Croxden Abbey, or such as the Earl of Warwick now has, are the type: good milking Shorthorns—not pedigree animals, bred for the show ring and the butcher, but milkers (shall we call them?) of Shorthorn type; such animals as will feed for the butcher with very little trouble, and make more when fat and out of the dairy than when in full milk. These are the animals to keep the money together, as well as to give plenty of milk. There is only one objection to them: they are costly both to buy and to keep. A gentleman, for whose knowledge we have the greatest respect, affirms that good Ayrshires will do just as well in the dairy, and backs his opinion by records. Where the Shorthorn type of dairy cow costs £25, the Ayrshire would cost £18, besides which she would eat considerably less. In a question of this kind, any intending purchaser would find it worth his while to investigate the doings of the Ayrshires; for if they would answer his purpose as well, it would be folly to lay out a much larger amount of capital upon the larger animal. We

have recorded the performances of the Ayrshire breed, and although we have known instances where they have fallen short, we are bound to say that we know cases where they have fulfilled all their admirers claim. Their home is Scotland, and a trip among them would not be costly, more especially if it resulted in a purchase, and the expense was divided among them. They can be purchased at very moderate figures, and selected animals in their second year purchased in calf would not exceed £17 to £18, including carriage to the south of England, if a truck-load came at once. Although we have referred more distinctly to Shorthorns and Ayrshires, an intending dairy-farmer should study the merits of Red Polls, and of large hardy English-bred Jerseys and Guernseys, if he intends to make butter. Each of these races has claims of quite as high an order as the above-named breeds. It is not superfluous to say that, in purchasing, the age should be tested both by the horn and the teeth; the teats should be examined, or one may be "blind"; and it should be seen that no disease or blemish exists. It is always wise to give a little more money for what you *know* is a good animal, whereas a doubtful one should never be purchased at all. In stocking the farm, the Ayrshire cows may be safely reckoned at £18 each, whereas it would hardly be wise to charge the Shorthorns at less than £25. At the same time, if a farmer determines to commence upon the safest ground, he will not hesitate to pay as much as £24 each for Ayrshires and £28 for Shorthorns, and a judicious selection of known milkers may be the making of his dairy from the commencement. They should all be of one type, unless, for instance, so many of one variety are purposely tested against another. Uniformity is a great point, whereas if all sorts of cows are purchased there can be no system, or what system there is soon gets into a hopeless muddle. Having decided on the breed, we would procure a bull of the best milking strain we could find, and in future save our

bulls from the choicest milker in the dairy. As we found that cows turned out badly, we would fat and sell them at once, and replace them with others until every animal was a good one, and then these in their turn would be replaced only by their daughters.

This brings us to the subject of testing the powers of the cows. What is worth doing at all is worth doing well; hence we would have every appliance requisite to enable us to carry out a complete system. Name every cow, give her a page in your ledger, and keep an account of her yield throughout the year. Provide the milker with a book or a slate, and require him to weigh the milk from every cow as he draws it. If the machine stands by him he can do it in half a minute, and then pour the milk through the cooler into the churn, and milk the next, and so on. By this means an accurate account is kept which nothing can disturb; but nothing can be done without a thoroughly competent milker. In addition to the cows a certain number of pigs will be required, according to the scheme of the farm—if milk is sold less will be required than if butter or cheese is made—and in buying these nothing can be better than middle-bred Yorkshire sows, with a thoroughly good white boar, which should be kept on the premises to ensure vigour, quality, and uniformity of breed. A good boar will more than pay for his keep by service for other persons' sows. The pig stock may fairly be estimated to cost £35, if 7 are purchased in profit, or 30*s*. each if about 3 months old, for a reliable breed only should be obtained, as all sorts of mongrels are sold for Yorkshires.

Now with regard to the buildings, there can be no doubt that the best are the cheapest. For say 40 head, we should prefer one large building with 4 rows of stalls of 10 each, the centre rows being head to head, with a passage between. Down this passage the food could be drawn on a tramway, or by cart, and delivered into every rack or manger. Passages should also be behind the animals in these rows, or between them and the others whose

heads are to the walls. They should all have collars and chains; the floors should be slanting towards the gutters to the rear of the animals, and made of impervious material. The gutters should lead to drains specially made to carry off the liquid manure to a receptacle where it can be utilised for the farm. Above all, the building should be light, lofty in the centre, giving plenty of air, and roomy. The calf-houses should be close at hand, and these should be airy, roomy, and at the same time warm. Some persons tie the calves each to a small stall, others let them run loose in a large shed, while others again shut them up in pairs. The stables we need not describe, as they belong to a department of the farm not exactly connected with the dairy. With regard to the pigs, it will be found that styes entirely under cover are the best. A brick building with a passage down the centre, and the sleeping-places shut off in compartments on either side, is the best form of house; and the outside yards, though open for a few feet, should be covered by a shed. In this way, if the floor is of cement the litter lasts a great deal longer, so much food is not wasted in the production of heat, and there is much greater cleanliness; besides which, the feeding is done in the centre passage by opening small flap-doors, and every pig is under perfect command, and can be inspected night or day.

Besides the buildings required, a cart-shed will be necessary; an implement shed—and this should not be a mere sham; a granary, where rats cannot enter at will; a tool-house, with a grindstone; a food-house for pulping, grinding, chaffing, mixing, and, if necessary, with a copper for boiling the food; a barn for corn, straw, hay, etc.; a hen-house; and, lastly, and more important than all, a dairy. The latter should be entirely sheltered from the sun, well-ventilated, without drains, and paved with slate or concrete, of which materials the benches for the pans should be made.

With regard to the machinery and its cost, a few words may be said, although it is no part of our scheme to enter minutely

into the subject of ordinary farming, a question upon which we are closely treading. In the cultivation of the land will be required ploughs, harrows, and rolls suitable to its tilth, horse-hoes and drills, mowing machine, hay-rakes, drag-rakes, forks, etc., two or three carts, ladders, poles, and rick-cloth, grinding-mill, root-pulper, oil-cake breaker, chaff machine for horse-power, milk-cooler, and railway churns; the whole of which, with the requisite smaller items, would cost not less than £100 to £150, according to the quality, and whether purchased new or secondhand. Another heavy item would be the horses, for although they would not all be required to work throughout the year, we cannot see how less than three would suffice, as in the cartage of milk one would be required every day. This matter would have to be left to the discretion of the owner. On a butter-making farm daily labour would not be absolute, and yet plough horses would scarcely be fit for lighter work. In that case a pony would suffice for all the light work.

Assuming thus roughly that 33 cows are kept, we believe that it would require a capital of about £1400 to fairly start a dairy-farm of 100 acres with Shorthorns, or £1300 with Ayrshires, for it must be remembered by those who deprecate farming with small capital that whereas the corn-farmer has to wait a year for his return in many cases, the dairy-farmer commences to reap his return at once.

We will now deal with a subject which most readers will be anxious to arrive at—the receipts—and having given a general idea of the items which will be found to arise under the head of expenditure, as well as outlay of capital, we shall be excused if we do not attempt to be too exact, for the reason previously specified. First of all let us deal with the sale of milk all the year round. It is not to be supposed that the whole of the animals will be in milk during a complete season in each year, nor should it be assumed that there is an entire absence of sickness, abortion, and barrenness. Some animals are sure to

slip their calves at some time among such a number, and others are as sure to go over their time for conception, no matter what trouble is bestowed upon them; but for the sake of the argument we shall base our return upon an average yield from each cow during forty-six weeks, leaving six weeks for rest prior to calving. Any practical man will know what this means, and he can value the estimate in accordance with his intended practice. If he chooses to keep a cow which has played him false in one of the above manners, he intentionally depreciates his return—and yet it may be wise to give a valuable animal another trial. A London cowkeeper has no such mis-chances to affect his average, as he generally buys newly calved cows, and sells them immediately he considers they have ceased to pay their way. Although a dairyman who breeds his own cannot thus control the performances, he can, by adopting vigorous measures, bring them so close to perfect control that, accidents excepted, he can fairly estimate their probable yield. If he fails to watch them closely himself—for however competent and devoted a man may be he cannot take the master's place in this respect—he will certainly not do this, for breeding requires such nice management that every time an animal is allowed to pass her period of "heat," she loses so many weeks' milk, and disarranges a system. It is therefore the best plan for a master to carry a herd book in his pocket, giving dates of last calving, and when calving is due, also the periods when it is desirable for cows to be put to the bull: the same rule applies to pigs. These dates should be given to the man, and his memory continually refreshed with regard to them, for young animals born at certain seasons, midsummer and midwinter for instance, are nothing so valuable as if dropped in spring or autumn; indeed, we have had spring calves quite as large in the following autumn as those dropped the previous December.

In this estimate we allow a fair margin, as we do not consider that anything intended to instruct or advise others with regard to

the investment of their capital should be too sanguine, much less extravagant. We have, therefore, allowed each cow 3 acres of ground (the remaining live-stock being of course included in this estimate), which no one will say is too little, but which many can easily prove is too much. If a farmer finds his land will carry more than this, then by all means let him obtain them, for every additional cow will be so much more profit without any appreciable expense. Thus, in dairy-farming, it is the best policy to farm high. It must also be remembered that a dairy farmer reaps two profits: the profit upon the growth of his crops, and that upon the sale of his dairy produce. The best plan to make this clear, and to ascertain how each branch pays its way, is to keep an account with each, debiting the dairy with the crops at proper prices, and so on.

Presuming, then, that 100 acres carried 33 cows, each returning an average of 10 quarts a day for 323 days of the year, or 818 gallons, the receipt from each would be, at 7*d.* a gallon, £23 17*s.* 2*d.* To simplify matters we have adopted the course of averaging the price, from which carriage and wear and tear of cans are deducted. Sometimes 9*d.*, and even 9½*d.*, will be received; at other times 8*d.*, and seldom much less than that. If, after the deduction of carriage, etc., the returns are less than 7*d.*, then we should give up the milk trade during the low-price season of summer and make butter. At this 7*d.* rate, then, the gross receipts from the cows would be £787 6*s.* 6*d.*, or deducting produce consumed in the house, let us call it £760.

There are, however, other items of profit which a dairy-farmer must not overlook; and first among these come the calves. Under the present system young calves are allowed a large quantity of new milk for some three months, followed by skim-milk and good artificial foods, costing at least £5 by the time they are six months old. We do not say that artificial feeding is so good as milk in all situations, but we believe that with a little trouble calves can be reared in most cases without so much new milk, and reared to

perfection; and instead of charging them £5 a head we should consider £3 ample for meal, cake, linseed, and any other good calf food to act as a milk substitute. At all events, we would certainly advise every breeder to *try* the system, as it must be his object to rear heifers of the finest and most vigorous type. If the artificial food is beaten by the milk, then give it up; if not, it will be found a great saving. When the calves have reached six months they may feed almost wholly upon the produce of the farm; at all events, if we estimate their profit at £4 a head we shall have allowed a margin for subsequent cake or corn feeding. Thus allowing something for losses, we will suppose 30 calves return a profit of £120. Heifers should be of the value of £9 or £10, and bull calves, if sold fat at eight or ten weeks, should pay very nearly as high a profit; at all events, an average of £4 a head is not an alarming or extravagant estimate.

Coming next to the pigs, it will be found profitable to keep them, whether butter-making is conducted or not. The pig is proverbial for paying his way if he is well treated, and good stock is sure to return a handsome profit under good management. If every scrap of corn had to be purchased we would still say keep pigs, and as the dairy where milk is all sold would not furnish any "skim," corn in some form would be required. The system we should adopt would be to breed and sell the young ones when old enough to wean. A sow properly managed will have two litters yearly; if she fails in this sell her and get another. Presuming that the 6 sows each litter as we suggest, with an average of 8, a very moderate estimate, but such as will allow for deaths and accidents, the case would stand thus: 96 young pigs per annum, which, of a good large breed and well reared, should always realise 16*s.* apiece, sometimes much more. We shall, however, charge each lot with food as though it were all purchased, and we consider £3 is not too much, as it will permit of the youngsters being finished off during their two last weeks with peas. There is then the cost of the boar and sows during

the remaining eight months of the year. In summer they should find enough on the pastures with green food from the garden and fields, and in winter their cost should not exceed 2*s.* 6*d.* per week each during four months, or £2. The pigs, therefore, stand thus :

CR.	
96 young pigs at 16*s.* ... ... say	£77
DR.	
Cost of rearing 12 litters at 50*s.*	£30
Cost of 6 sows, 4 months at 2*s.* each per week say	10
Cost of boar for year	5
Ringing, cutting, depreciation, etc. etc.	5
	£50
Profit	£27

to which must be added a considerable sum for the value of the manure.

The last department of receipts is the poultry, and here, as in the other branches, system will be found to be the one thing needful. To keep 100 mongrel hens without an atom of breed in their constitution, and which return an average of 50 eggs apiece during the year at a cost of perhaps 2*d.* a week per head for food will never do. Poultry kept "anyhow" is bound to lose money; but, on the contrary, if it is properly kept it will surely make it. To commence with, we should procure in the autumn a young Dorking cockerel of the year and a number of big strong black Hamburg or Houdan pullets or young hens, or, if preferred, a light Brahma cockerel and silver-spangled hens all in full lay, as late-hatched birds would be of no use. These we should turn down in the farmyards; a cock would be necessary for every 20 or 25 hens. By the 1st of December commence to set the eggs in order to hatch early, and go on setting until the end of February. Early hatching is the only way to make a maximum profit, and to this end, as the trouble would be found considerable, we should employ some one for the purpose who thoroughly understood the work, or put out the eggs to be hatched and reared by cottagers. Pay well for the work, and if

well done it will pay you. After the setting ceases the eggs may be sold, although until the pullets begin to lay there will not be many. As many chickens should be hatched as will yield about 150 pullets from the cross, which should be about the average numbers kept. Cocks will not be necessary, so that directly the young males are ready for market they should be sold, and the probability is that they will be fit about April, May, and June, when they are of the most value and will doubly pay the cost of rearing. The pullets will begin to lay by July (we have had them lay by the middle of June and sit in July), or at all events many of them will, the rest following in August and September, and they will continue to lay, with now and then a rest of a week or two, until the following July, laying through winter when eggs are dearest as well as in summer when they are cheapest. It is not of course absolutely necessary to hatch every season, but it is the most profitable to do so, and sell the hens about July when they have ceased laying and begin to moult; they will then be fat and sell well, whereas if retained they will cost a considerable sum without being productive. They may, however, if time cannot be devoted to them, be kept for another year, and the result will be far better than from common hens, although not so good as from pullets. There is one thing to be remembered: the pure birds, and those only, must be used for breeding, and for this purpose they should be set apart, with a house some distance from the homestead and allowed to run loose. As it will not be convenient to purchase them every year we advise that a fresh cock should always be bought, but the hens can be hatched and reared with the others, if at the end of the hatching season in February a cock of the same breed is put to them and the other taken away.

It may be assumed that if the tail corn and maize are used, and the latter can be purchased during its cheap season at 27*s.* a quarter, the birds will not cost more than 1½*d.* per head per week or 6*s.* 6*d.* per year, such year being estimated from July to

X 2

July, the season of laying, during which they should produce from 120 to 140 eggs of the value of at least 10*s.* 6*d.*, shewing a profit of 4*s.* per hen. The cost of rearing the pullets will be more than balanced by the sale of the hens, whereas the cockerels—and at least as many should be reared as the pullets, viz., 150—should show a profit of 1*s.* each. These estimates are sufficiently liberal to allow for minor expenses, of which we have taken no special notice. It does not come within our province in this instance to enter into any details of poultry management, for which we must refer to our writings elsewhere. The poultry-yard thus shows a return of—

Cr.	£	s.	d.
150 laying hens, at 10*s.* 6*d.* for eggs	78	15	0
150 cockerels, at 1*s.* profit	7	10	0
	86	5	0
Feeding 150 hens, at 6*s.* 6*d.*	48	15	0
Cost of cocks, deaths, &c.	2	10	0
	51	5	0
Profit	£35	0	0

The profit estimated is specially applied to a farm of the nature of that we are describing. Labour, rent, food, buildings, and conveyance would under ordinary circumstances entirely prevent a profitable result where so many birds were kept.

To sum up the receipts and expenditure, we find that the former are as follows:

Cr.	£	s.	d.
From receipts for milk	760	0	0
,, Calves	120	0	0
,, Pigs	27	0	0
,, Poultry	35	0	0
	£942	0	0
Dr.			
Expenses of working farm	455	0	0
Interest on £1400	70	0	0
Depreciations and repairs	45	0	0
	570	0	0
Profit	£372	0	0

We now proceed to estimate the probable returns upon such a farm where butter is made and the skim-milk fed to pigs. It is generally estimated that 2½ gallons of milk will make 1 lb. of butter, and this would give every cow an average of 7 lbs. a week, but we prefer an estimate of 3 per cent. of the milk. Thus the weight of each cow's milk for the season of 323 days at 25 lbs. 10 oz. a day—the gallon weighing 10 lbs. 4 oz.—would be 8277 lbs., and the butter from this would be 248½ lbs., which, at 1*s.* 4*d.* per lb., would be £16 11*s.* 4*d.* We are quite aware that in summer so much could not be realised per lb., but in winter and spring a great deal more would be obtained, so that the average price is a fair one. The return of the 33 cows for butter alone would thus be £546.

We have now to deal with the buttermilk and skimmed milk, weighing about 8000 lbs. per cow and containing above 9 per cent. of solids. If we allow one sow to every three cows, we shall have 11 or 12 head, with a boar—and we believe that the milk would be sufficient, not only to keep them in splendid condition, but to fatten young porkers as well, still leaving a quantity for any other purpose. If the same average is assumed, we should have double the number of pigs, one-fourth of which should be fatted and sold for young pork about twenty weeks old. Our pig receipts would now represent:

	£	*s.*	*d.*
Cr.			
144 weaners, at 14*s.*	101	0	0
48 porkers, at 45*s.*	108	0	0
	£209	0	0
Dr.			
Cost of peas for porkers	12	0	0
Occasional food for other pigs	20	0	0
Cutting, ringing, and depreciations	10	0	0
	42	0	0
Profit	£167	0	0

With regard to the calf account, we need make no alteration. If anything, the expenses would be less, on account of the use of skim-milk, which would be plentiful at some seasons, and from which with the buttermilk very good cheeses might be made for the house.

The poultry, too, would remain as before.

ACCOUNT OF BUTTER-MAKING DAIRY.

	£	s.	d.
CR.			
Receipts for butter	546	0	0
Calves and poultry as before	155	0	0
Pigs	167	0	0
	£868	0	0
DR.			
Expenses as before shown	570	0	0
Extra expenses in dairy	10	0	0
	580	0	0
Profit	£288	0	0

The above may or may not be of value to readers of this work, but they can, at any rate, rest assured of one thing—that it is not a theoretical chimera, but a simple account of such a dairy-farm as many would desire to undertake, and it is entirely based upon a practical knowledge of the subject.

It is quite possible that, whether butter is made or milk sold, a dairy-farmer would do better than to sell his young stock; indeed, he ought to rear them to maturity, and sell his cows fat as they fail. But the profits would, if higher, be estimated in a similar manner. Under the present system of preserving crops in "silos," which we cannot too strongly commend, a larger number of animals could be kept and the returns increased; indeed, the milk yield is based upon an estimate which few men ever reach, although it ought to be a general one, so that without really high-class catttle and first-rate management the returns would fall short of our figures without young stock was reared. With regard

to the profits of the butter dairy, it may be pointed out that by using the small farmers' Danish Cream Separator, which the pony could work, the skimmed milk could be sold to much better advantage than if it were given to pigs. If, however, the farmer chose to strike out a new line, and manufacture some of the cheeses described in this volume, his skim-milk would still yield a capital profit.

CHAPTER XVIII.

AMATEUR COWKEEPING.

If people who have but little space at their command knew how easily a cow could be kept, and what an abundance of good things she would return, we think cows would be far more generally kept than they are. Somehow or other they are associated with buttercups and green fields; and many who never dreamt of the possibility of keeping one would undoubtedly do so if they knew that the former were disliked by the cow, while the latter are by no means necessary, if she can obtain fresh air in any other way. It is only necessary to visit one of the less important London dairies, and see under what circumstances a cow can exist—and, indeed, be kept at a profit—to be convinced that the cow of the amateur would literally live in a land of milk and honey by comparison. Not long ago we went over such a dairy of 100 cows, and never felt more disgust. The sheds were dark and low-pitched, the alleys down the centre were mere drains, the stalls small and cramped, and the whole place was redolent of filth; yet from it was carried probably 200 gallons a day. Instead of the straw-covered stalls and clean airy passages seen in the country, there was nothing but water and dung; and yet the cows seemed to do fairly well. It is true they never had a very long spell at the business, for the owner was constantly buying in newly-calved cows, and selling those which had gone off in milking properties. These generally go

to the butcher if their condition is good, otherwise many of them find their way to the Cattle Market, especially the screws, where they sell in most cases to persons who make it their business to buy at screw price, and sell at something very different to the unskilled. Amateur buyers cannot be too careful in buying cows, for there are almost as many tricks played with them as with horses.

In London, then, we may take it that cows are almost all stalled, not even having an exercise ground, nor an opportunity to stretch their legs until they go to the shambles. In the country it is different, and more systems are fashionable. The majority of farmers house their cows during winter, and turn them into the pasture in summer; and perhaps, on the whole, this is the easiest plan, although it is questionable whether it pays the best. There are many ready to defend the system of house feeding in summer, and others who consider tethering the best plan. In the first case, the chief trouble is in driving the animals to and from their feeding ground, and in mending fences and seeing that they do not stray. In the second case, there is the daily task of cutting the food in the summer, and cleaning out the stalls. There is also the cost of longer feeding than when the cows are turned out, and of straw through the summer, unless it is grown and cannot be sold off the farm; but against all this there is the manure, and further, an increased supply of milk during the hottest weather, when cows in the field are tormented with flies. Again, the system of tethering entails the cost of ropes, collars, and pins, and loss of time in continually moving the cows. The chief value of the two latter systems, however, is that they enable any one to keep a cow on a smaller plot of ground than by pasturing; in other words, a greater number of cows on a given acreage than under the old system. A person may have very little grass, very little garden ground, or, in fact, no ground at all, and yet be able to keep a cow; and we would go so far as to say that, although it were necessary to

buy everything, we believe a good cow would even then pay handsomely. Where a piece of good land is well cultivated, it is astonishing what it will grow; and if simply half an acre is allowed to get well forward and is not commenced to be cut, say until May, it would be found to provide almost all a cow would require for best part of the summer. We are referring to grass; but even if crops of another nature are grown, such as comfrey, which is the earliest green food known in this country as well as the most abundant cropper, we should still have no doubt of the result, for as fast as the ground was cut it would be ready again. Comfrey is a food that has made its way by its merits alone; and although it is a fine plant for a farmer, we call it the amateur's own, for he can put it anywhere, and cut it for any stock, and there is nothing they relish more. We have grown it for a few years, and like it better every season, and during the past winter we have planted a large shrubbery with it, having proved that it will grow under the trees. It likes manure more than any other plant we know, and we have seen the crowns buried in it so strongly that those who did not know its nature believed it would be destroyed.

Now let us see what are the requirements for keeping a cow. Most—it may be said all—families prefer home-made butter, and milk and cream of home production. A cow, then, would necessitate an outhouse in which she could be confined all, or a large portion of, the year; a small, cool room, which could be used as a dairy; and a number of utensils. The knowledge of her management, the manipulation of the milk, and the butter-making, would be a labour of love, and easily acquired under such conditions. The cost of the utensils, indeed, would be comparatively heavy for a single cow, as the price for half-a-dozen would be little more. The cow-house need be nothing more than a plain, stable-like, loose box or stall, dry, warm, and free from draughts, fitted with a rack and manger, and a water-trough. The front of the stall near the manger should be a little higher than

the back, where a small gutter should cross it, and carry off the liquid manure to a pit outside, for use in the garden. Overhead, or near at hand, should be a compartment for storing and preparing food, a chaff-cutter, root-pulper, and cake-breaker. These machines are again somewhat expensive to buy for a single cow; but the same argument would apply to every person keeping one horse. At the same time it may be mentioned that all these things can be obtained at farm sales at about half-price, and such sales occur regularly in all farming districts. The articles necessary for the dairy, while they also may be obtained in a similar way, had much better be purchased of one of the large houses, for the simple reason that of late dairy utensils have undergone such a change that, unless they are bought new, it is not possible to obtain the best. Thus, if the old-fashioned open shallow pan is adopted for setting the milk to cream, four will be sufficient, costing 3*s.* 6*d.* each; a strainer, with ladder to stand across the pans while straining, costs 5*s.*; a skimmer, 1*s.*; a cream-pot, 3*s.* 6*d.*; a milk-pail, which some prefer gauged, so that it can be readily seen what milk a cow gives, 5*s.*; butter-prints, beaters, and knives, 5*s.*; a churn, from 45*s.* to 60*s.*, according to the pattern used; and a miniature butter-worker, which will save much time, and do its work far better than the hands, 15*s.* Of churns there are three or four styles, which are fully described in another chapter. A thermometer will be required to test the temperature of the cream for churning, while a graduated glass, which can be bought for two shillings, and which is called a creamometer, will, from time to time, show the quantity of cream given upon certain feeding. Thus, for a little more than £5, the dairy can be furnished; and if the new deep-setting system is preferred, it can be adapted to a very small room at a very little more cost.

Having arranged the cowhouse and dairy, the cow may be purchased; but what kind should she be, where should she be obtained, and at what cost? As butter-making will necessarily be an imperative affair, the required cow should be a rich as well

as a large milker, and to this end a search should be made for a cross between a Jersey or Guernsey and a Shorthorn or an Ayrshire. The two Channel Island races are rich milkers; but while the two last-named are not so rich in cream, they give more milk, and are, moreover, of more value when done with, which is something in their favour. A strong cross between the two would probably be a deep and also a rich milker; she would be more vigorous than a pure-bred Jersey, and more readily fatted and sold in case it became necessary to sell her. This is an important point with an amateur, who is more easily induced to buy if he thinks his principal is safe as well as his interest, and, indeed the inducement is very sensible if it can be shown that an animal costing £20 will give milk for some years, and still sell for £20 at the end of the term, just by spending a little money in fattening her. There are, however, Jerseys and Guernseys of large, vigorous type, which are first-rate animals for the purpose; but they are coarser than the modern type, and, in order to sell them well, it is necessary to part with them before their natural term of service has expired. We have known such animals, when thoroughly well fed, give from ten to fifteen quarts a day for many months after calving, although continually stalled. Their butter yield is large, while all the surplus milk is readily sold at 4*d.* a quart; so that it is seen by a little calculation how well a good animal will pay. Of course it is much easier to buy a cow when no specified breed is required, than when a particular animal is wanted. There are highly respectable dealers near London who sell Jerseys and Ayrshires; but in buying in this way a higher price is usually paid, perhaps naturally so, considering that a cow can be warranted. There are also numbers of gentlemen within easy distance of town who breed and advertise. A visit to their herds cost little but time. The money is well laid out in the additional experience gained, even though no purchase is made; and, in looking at herds, it should always be remembered that quality is required in a milker

more than beauty, so that a buyer should be at all times on guard against himself. Again, popular mediums for the advantage of both buyers and sellers are continually increasing in the stock sales and dairy shows. In *The Field* will be found from time to time announcements of the sale of particular herds throughout the country, where magnificent animals may often be bought for moderate prices, especially when milk is the main feature required, and not colour or exhibition points. As for the dairy shows, they are to a great extent gigantic sale meetings, and generally a large number of high-class milkers are brought together, affording a buyer an unusual chance for the purchase of good cows. Should, however, a particular bred animal be required, such as we have just suggested, an advertisement in one of the leading stock journals will generally secure it; but it should be seen, examined, and the milk drawn in the buyer's presence. A good, newly calved animal, not exceeding five or six years, will cost £23 to £27. She should be sound, especially in the udder, as many animals have a blind teat, and consequently have lost a quarter of their milk; and, if possible, it should be ascertained how she was fed, as some men feed with great liberality for a few weeks in order to sell a screw at a higher price. As the great value of a cow is her capacity to milk well for a length of time, rather than to give a large supply per diem just after calving, it is always a good plan to ascertain what she did with her last calf, taking statements from some strangers *cum grano salis.* If she is in calf, and to a bull of good milking blood, the calf when dropped, if a heifer, should be saved and reared to take her place when she is sold. In buying a cow, a licence is very often necessary for her removal from a certain district, as it is also to a certain district. In sending by rail, a horse box will be reasonable on some lines, while on others its cost is preposterous, and in this case a half truck should be engaged. Most cows can be led very well with a rope, fastened with a noose round the horns.

The cow has now arrived, and the next subject is how to feed and manage her. The more general foods given to stall-fed cows are hay, roots, grains, straw, chaff, corn and pulse meal, oil cake, cotton cake, and artificial grasses. Some of these are no more expensive in town than in the country, while others are much dearer. It is generally accepted that a good cow will pay for high feeding; and if she will pay in the country, where the milk is not worth so much, she must pay in town; hence such feeding will be found economical, and for a second reason, that she will require less hay and roots, which are much too high in price to be used as they ought to be. Decorticated cotton cake is a good food for milking cows, if it is good, but as it is often much adulterated, it is well to go to thoroughly reliable salesmen, or one may pay heavily for rubbish, as some farmers do for artificial manure. Maize and pea and bean meals are also most valuable for milking cows; and our advice would be to a cowkeeper, wherever he may reside, to buy maize at Mark Lane when it is cheap, say 27*s.* the quarter, and beans of a farmer, who will oftentimes sell at a low figure when the market is dull. Whether the profit of an animal is something or nothing, greatly depends upon how corn is bought, and no plan can be more expensive and troublesome than purchasing once a week of the nearest corn-chandler. A small mill can be purchased for 35*s.*, which will grind all the corn as required, thus saving the expense of grinding; and this meal can be daily mixed with chaff or grains, which it will induce an animal to clear up. Proximity to a large town is an advantage in the matter of obtaining grains, which are most valuable for the production of milk; but in some cases the demand is great, and the price consequently quite high enough.

Hay is a very necessary food, perhaps the most necessary, and a glance at market quotations will often frighten a buyer in a small way. Market prices are not, however, always reliable; this fact we cannot put too clearly upon record, and unless great care

is taken, whether by buyer or seller, there are salesmen who will cheat them. Some of these men are mere dealers, buying and selling for themselves, while others, who ostensibly sell on commission, pay their customers just what they like, especially if they are not well informed upon market customs. This middleman business is in few hands, and the few try to keep it there; but a penny fee will at any time take an inquirer through the market-book, so that *bonâ fide* transactions will show just what hay is selling at. There are hundreds of farmers who live within carting distance of large cities, who are only too glad to learn of a medium to sell not only hay, but straw and roots, at much less prices than the salesmen charge, and it is simply astonishing that London buyers will patronise an antiquated system, when they can readily buy from the grower, who will deliver it direct and charge them much less than they have hitherto paid, simply because he saves commission, market toll, and imposition. A very large buyer, a gentleman who is a senior partner in a gigantic City house, once told us that he could always buy well of the salesmen in a large way, and the reason was that growers sent up truck-loads of hay by rail, which the salesmen sell without troubling themselves about top prices, or disturbing their regular customers. We know that hay and straw can repeatedly be bought at two-thirds town prices if bought direct from the grower, and if a little trouble is taken soon after harvest, good oat straw will be found and purchased at 15*s.* to 17*s.* per load, and chaff and hay at proportionate rates. This is the way to buy, when for a fair price a farmer will deliver sufficient of each for a whole year. Oat straw is one of the best straws for chaffing with hay, and if good it is useful given in the place of hay when a cow is dry and does not need high feeding. Wheat straw is the best for bedding; and some prefer it for chaffing. Barley straw is largely used, but it is not so good either for food or bedding. Some people use sawdust for a cow's bed, others prefer tan, but these things are generally used where they

are found to be cheaper than straw. In the country roots can be bought at 12*s*. a ton; in London they reach 18*s*. to 20*s*. So that again something may be saved.

While a cow may cost 15*s*. a week if she is fed highly, and her food bought carelessly, yet we believe that upon the principle here laid down she can be splendidly fed for 11*s*. a week, and get 10 lbs. or 12 lbs. of meal a day, besides hay or chaff, roots or grains. These last need not be bought too often, for, if well pressed down and kept from the air, they will keep for a length of time.

We may then put down the cost of the cow at £28 a year—her manure will more than pay for any little extra expenses that are sure to crop up. How then is such a sum to be accounted for on the cow's part? Our own impression is that it is quite possible to obtain a cow and manage her so that she shall return an average of 10 quarts a day for, say 320 days in the year. Be this as it may—supposing 8 quarts is made the basis of the return, this would give 640 gallons, which all who are practical men, will consider a most moderate estimate—perhaps not so much where many are kept, but decidedly moderate as applicable to an amateur's cow.

As the whole of the milk could be sold at 4*d*. a quart near or in a town, and as it is fair to charge such a sum as would be paid if a family purchased milk, it is only correct to estimate its value at this amount, which would give over £42 per annum, showing a liberal profit, where perhaps profit is not sought, besides the advantage and pleasure of having the best of milk, butter, and cream.

In keeping a cow the chief labour is in keeping her and her stall clean, and in milking and feeding. She should have clean water and rock salt always beside her, and her food had better be given thrice daily—varying it, for cows, like men, like a change—sometimes chaff and meal, at others, grains and meal, and again at others, pulped roots or green food, when it can be obtained.

If a piece of grass can be utilised, she should be tethered upon it as often as its size will permit. All cows benefit by grooming, especially as they are very liable to the attacks of insects. Milking is best learned of a good milker—we need give no instructions upon that point. A good cow will milk the whole year, but it is best to arrange for her to be dried six weeks before calving, and in order that she shall calve regularly, care must be taken that she visits the bull when in season; this, too, a practical lesson will explain. A cow goes about 280 days with her calf, but the time varies as much as a week. Calving is generally foretold by the state of the udder, for when it begins to enlarge it is called "springing;" and when it reaches its normal size when in milk, the calf may be expected. We have generally found that if a cow goes over her time the calf is a bull. Most cows calve without assistance, but some one should always be at hand in case aid is needed. The calf lies with his head and fore feet to the world, and in some cases manual help is necessary to assist the throes of the cow in parturition. When the calf is born and dry, and the after-birth has parted, the calf should be put to the teat to draw the first milk. There are systems of weaning which we can strongly recommend, but in a case of this kind it is simpler and better to allow the calf to suck one-half of the milk for a few weeks, by which time it should be taught to drink skim-milk, and to eat hay, roots, and oil-cake dust. If it is a bull, it had better be fatted on new milk, and sold in a couple of months, when, if a good one, it may fetch £5 to £6; but if it is a heifer, and likely to be valuable, it should be reared, if it can be conveniently fed, until it can be turned out to grass, when there are plenty of farmers and others who would graze it at 1*s*. 6*d*. a week, increasing a little as it grows older. Indeed, it can be left on some farms until it is fit for the dairy, and should return a good profit.

With regard to butter-making, a subject which is described elsewhere, it may be noted that in few cases is it so profitable as

selling milk. The skim-milk should be sold, for this would be found more profitable than giving it to pigs or making cheese—that is, if it is not all used in the house, but there is no question that its consumption there is the most profitable of all. Whether sweet or sour cream butter is made is a matter of taste ; both systems have their partisans. We have always preferred it of sweet cream, especially if it is granular, *i.e.*, made up directly it forms in granules in the churn. A good cow will undoubtedly half keep a sow, and enable her to bring up two litters of pigs a year. If, however, pigkeeping is added to the cowkeeping, the subject would need fresh treatment, in order that the advantages of combining the two might be shown. We have never had any doubt at all as to the possibility of keeping a cow to profit, nor would we advise that a small animal, such as a Brittany or a Kerry, should be purchased, for these give as much trouble and eat nearly as much as an animal which would make the return double. If consumers were aware from what filthy dens much of the milk came, and how extensively it is still adulterated, there would be hundreds who would start a cow of their own at once. The large milk companies, in London and other large cities, have done a great deal to make milk popular by its purity and richness, but only the public itself can stamp out the iniquities of the system. Not many months since, a very large cowkeeper assured the writer that "bosh" milk was largely sold in the East-end, and he said he was satisfied that it could not be detected. This we hardly credit, but at the same time the police courts, and sometimes the medical journals, tell us how prevalent adulterated and impure milk is.

In case the objection should be made that we have been too lenient upon the side of expenses, and too sanguine that losses may not occur, we may remark that, were it necessary to engage extraneous assistance for the management of a cow, an objection might fairly be raised. We have written for those who either have employés able to do what little a cow demands, or who

would consider it a pleasure to attend to her themselves, as some devote time to a horse, dogs, or poultry. While we believe that, even upon a strict commercial basis, it would be found profitable, yet it is apparent that the results of misfortune or accident—such as the death of the cow—could not fairly be brought into the account, as it would in the case of a trading cowkeeper. We look upon the amateur's cow as a medium of affording, in the vast majority of cases, much pleasure and decided profit.

CHAPTER XIX.

CONTINENTAL DAIRYING—FRANCE.

Cheese-making.

The French — and it will scarcely be believed — import an enormous quantity of cheese, and according to "*Étude sur le commerce des Beurres et des Fromages en France*" by Pouriau, the German exportation of soft cheese into France exceeded that of France into Germany by 571,000 kilogrammes in a recent year. The Netherlands also send into France a very large quantity of cheese; indeed, one-half the imports of hard cheese by the latter country are from Holland. From Switzerland over 7 million kilogrammes of Gruyère are imported annually. France sends to Italy her Gruyère, Roquefort, and other cheeses in exchange for Parmesan and Gorgonzola, the balance of trade being, although only during the last two or three years, in favour of France. France also sends large quantities of hard cheese to Germany, Belgium, Algeria, Egypt, and to most of the other European countries not mentioned, as well as to South America and her colonies. The result, however, is that she pays 17,000,000 to 18,000,000 fr. more than she receives. In the year 1879 the value of the cheese sold in the Paris markets exceeded 5,500,000 fr. in value, or 2,000,000 fr. more than in 1873; and it will give some idea of the popularity of the Brie when we state that, of this sum, 2,500,000 fr. were spent for that

cheese, the Livarot coming next with 450,000 fr., the Mont d'Or with 349,000, and the Neufchâtel with 163,000. Thus the Brie alone far exceeded the whole of the other cheeses of France, in addition to the makes of England, Switzerland, Holland, Germany, and Italy. One of the chief reasons for the existence of this extraordinary fact is that all cheeses, whether French or foreign, which are denominated dry, are charged an *octroi* duty for entry into Paris of 9*s*. per 100 kilogrammes, whereas the fresh cheeses, such as the Brie, pay no *octroi* duty at all, although they are subjected to a market right of 1 franc per 100 kilogrammes. The consumption of cheese in Paris is estimated at 11,000,000 kilos. per annum, which is divided equally between hard and soft cheese. Thus each inhabitant would appear to consume somewhere about 12 lbs.

There are in France a variety of cheeses which vary in consistence, constitution, flavour, and ability to keep, and these differences are rather owing to the process of manufacture than to the nature of the soil or the peculiarity of the climate. The various denominations applied to them, too, indicate differences in manipulation rather than any change in their matter. Nevertheless, we are far from partaking of the opinion of those who deny that both sun and soil have any influence; for, as with wine and cider, so with butter and cheese, the pasture has a marked action upon aroma and quality. If we consider the general manner or process of manufacture, we find that it comprehends five distinct operations, which in France are called: 1st, *coagulation du lait*, or the formation of the curd; 2nd, *rompage*, or breaking up of the curd; 3rd, *égouttage*, or drainage, which is accompanied in some cases by *pressage*, or pressing; 4th, *salaison*, or salting; and 5th, *fermentation*, or maturing of the cheese. It is in the various methods—many of which differ very little from each other, and in all of which these operations are in force, but carried out under different conditions—that it is found possible to make forty or more varieties of fine cheese, which are divided into four categories:

1st, fresh soft cheese; 2nd, salt ditto; 3rd, firm, or medium-pressed ditto; 4th, cured cheese, more or less hard and pressed.

In the first category we have the Neufchâtel, the manufacture of which is extensive and profitable in the district of Bray; the Brie, the Pont l'Evêque, and the Camembert may be mentioned

Fig. 111. Milk Pot.

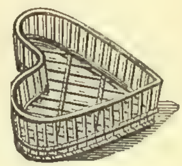


Fig. 112.

as examples of the second; Roquefort and Dutch, of the third; and Gruyère and Parmesan of the fourth.

Utensils used in Soft Cheese-making.

The articles used in the process of soft cheese-making in France, although they vary considerably in their size and form,

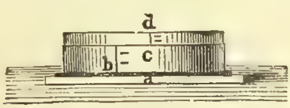


Fig. 113. *a*, Board; *d*, Hausse; *b*, Mat; *c*, Eclisse.

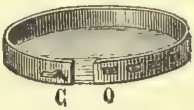


Fig. 114. Éclisse, with Hook (*G*) and Eyes (*O*).

are not numerous, and may be referred to in a few words. In addition to the ordinary milk-pans and vessels in which the curd is set, the principal articles employed are moulds, mats, willow drainers, and boards. The moulds are made in a variety of shapes, square, round, and heart-shaped being the most universal. In some cases, as in the Brie, two moulds are necessary for a single cheese, the top one, which the French call *la hausse*, fitting

into the bottom, and thus enabling the cheese-maker to put the whole of the curd required for each cheese to drain. After a few hours' draining the curd sinks into the bottom mould, and the *hausse* is removed. Another mould used is called an *éclisse*. This is employed both in the manufacture of the Gruyère and the Brie, although one is a hard and the other a soft cheese. When the curd has well drained, the *éclisse*, which is shown at Fig. 114, and which is a mould open at one side, is slipped over the mould already upon the cheese. It is then hooked to the required diameter and the other mould removed, leaving it in possession of the cheese, which it keeps together. All small moulds are better made of metal, and preferably of tinned iron,

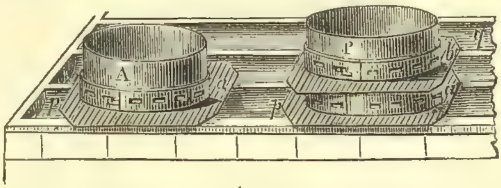


Fig. 115. Moulds as used with the Éclisse. A and P, Moulds; *a* and *b*, Mats and Boards; *q*, Draining Table.

although we have seen tin and zinc moulds used with good effect. The mats (Fig. 127) which are used are generally made of fine rye-straw, in which there are no knots, or equally fine rush, the latter being preferred. The osier drainers (Fig. 130) are principally used for Brie, but they are useful for any soft cheese, although they are rather expensive, as the work must be both fine and level, otherwise it gives an ill shape to the cheese. These are termed in France *clayons*, or *clayettes*. The cheese-boards are usually made of beech, but any wood will do which will not impart a taste to the cheese, and which will not warp or crack. Although measures for rennet and salt are not exactly cheese implements, yet they are of the highest importance in a soft cheese dairy, for the rennet should be measured to the greatest nicety.

Fig. 116 shows the larvæ of the fly (*Piophila casei*) which are found in cheese, and also of the house-fly (*Musca domestica*). The

Fig. 116. Flies' Eggs and Larvæ.

former are about three-sixteenths of an inch in length. The eggs are laid upon the cheese, and at the end of two or three days the

Fig. 117. Cheese Mite.

larvæ shown at *a* are hatched. They are of a yellowish white in colour, with pointed black heads. In less than a week they are transformed into the chrysalis *b*, from which the flies are produced

two or three weeks afterwards. The larvæ, shown at *c*, of the domestic fly, are twice as long as the above; and the chrysalis *d*, into which it changes, is also larger. Both insects are most objectionable in the cheese-room, and should be excluded by means of fine wire gauze placed outside the windows. The mite is shown in Fig. 117, and has been described by various writers under the name of *Acarus domesticus*. Pouriau, to whose work we are indebted for the illustration, states that it shows the insect from below, after being subjected to a magnifying power of 175°. The mite can be removed from the majority of hard-crusted cheeses by regular brushing, which must be followed by a brushing with salted boiling water. The latter should also be applied to the shelves upon which the cheeses stand.

Now, let us first consider the five principal cheeses of Normandy, and their modes of manufacture; and having visited many of the districts, and seen what an important industry it is, we have less hesitation in quoting M. Morière and M. Paynel (of whose farm we give a description on the next page), with regard to the usual proceedings.

When we hear of the wonders which are performed in Normandy, we are apt to forget that it is, or was—because, geographically, it no longer exists—an immense tract of country, embracing several Departments, and that the dairy industry, as a speciality, is not conducted in all. More correctly speaking, perhaps, it would be right to say that the best cheese-making is in Calvados, and the best butter-making in Manche, although both Departments are celebrated for each product. As Normandy dairy produce is now well known in this country, as it is so proverbially good, and that our own makers may be informed of the system under which it is made, and learn something of the people themselves and their cattle, we have visited farms in each of the chief Departments, and seen all that could be seen by individuals who were not expected.

Among other prominent agriculturists to whom we carried

introductions was M. Cyrille Paynel, of Mesnil Mauger, between Caen and Lisieux, who is perhaps the most celebrated maker of Livarot and Camembert cheeses. On the judging day at

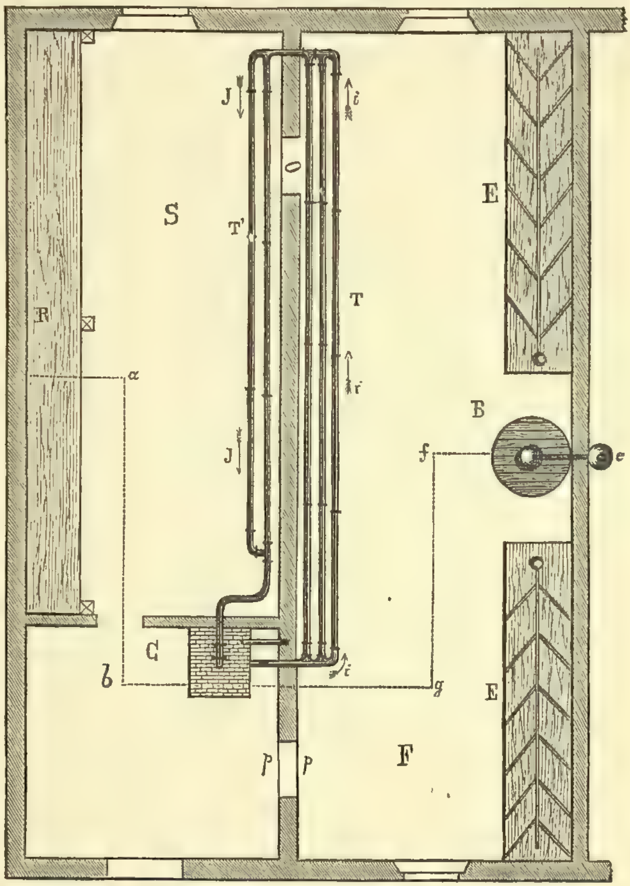


Fig. 118. Plan showing the system of heating two Cheese-rooms.
F, Apartment in which the Curd is set, drained, and salted; S, Drying or Ripening-room; C, Boiler; T, Pipes for hot water, as shown by the arrows *i i* and J J (these pipes are placed under draining-shelves similar to those at E E in the Cheese-room, and under a tier of shelves similar to R in the Drying-room); O, Door; *p p*, Double Door.

St. Lo, while the Norman cattle were paraded before three or four members of the jury, a stentorian voice was now and then heard from near at hand, and to this every attention was paid; the cowmen and maids sought to catch his eye, and the jurors paid him deference. He was a somewhat short, very stout, ruddy-faced old gentleman in a smock frock and silk cap, sitting upon a walking-stick with a small seat near the handle, and which served for stool and stick combined. He was the drollest of looking men, with a huge pimple on his face, and the most marvellous confidence in himself. This was M. Cyrille Paynel; but, while we marked the man as the most prominent person in the show-ring, we did not identify him until he came to the door of his farm to see what we wanted, thus interrupting him at his déjeûner. A few words and we enter, first of all to listen to a short preparatory introduction from M. Paynel, whose speech bore the ring of the oft-told tale. This over—and we may mention that the gist of it was, that the family of Paynel have made the Camembert what it is, and that his ancestress, Marie Fontaine, invented it in 1795, and originated the four houses of Paynel, at Mezidon, Mesnil Mauger, Champosoult, and Grandchamps, and that he, M. Cyrille, had himself invented a number of implements and machines, models of which surrounded his well-arranged trophy on the wall. The trophy contained facsimiles of his Prix d'Honneurs, and the six large and sixteen small Gold and twenty-two Silver Medals, which he had been at various times awarded, while in the centre was a genealogical tree showing the descent of the Paynels from Madame Fontaine. M. Paynel farms four farms, of which 112 hectares are grass, the property belonging to the Count de Monteau. His capital invested in the cheese-making business amounts to 75,000 fr., while that of his son, who lives close at hand, amounts to 46,000 fr.

Several of the best animals were in the meadows around the house, and they were certainly very fine beasts from a dairy point

of view, and some of them had taken prizes. It is worthy of note that the piggeries were large buildings, the inside with sparred floors—as recommended so often by poor Mr. Mechi—the spars, placed about an inch apart, were some 3 inches wide, and no

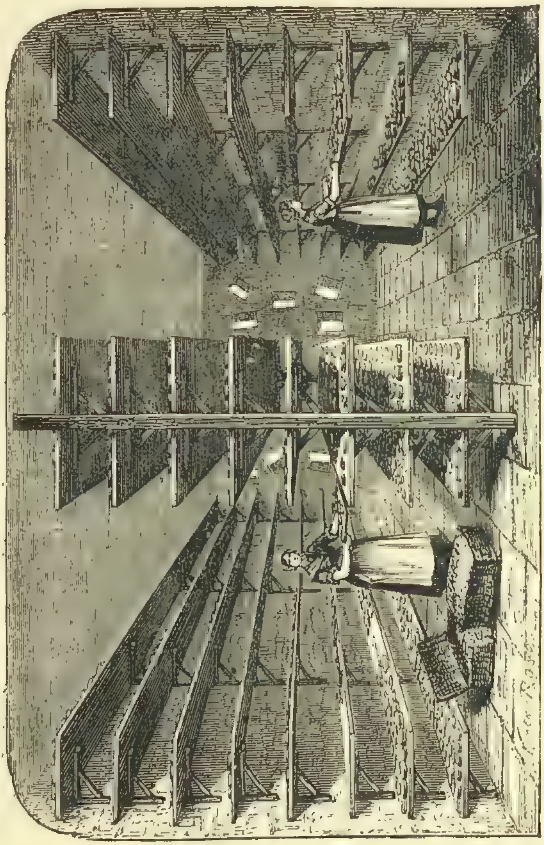


Fig. 119. Camembert Cheese-making.—The *Séchoir*.

straw was used upon them. The whole of the manure finds its way into a tank, from which it is pumped into one of our host's patent water-carts, for transport to any portion of the farm. The pigs, of course, get the whey, besides a good deal of barley meal and maize.

The residence, lengthy as it was, seemed to be divided into but three rooms on the ground-floor, and was designed for work rather than comfort. To the right was the, as we thought, decent-looking kitchen, but, in reality, rarely-used best apartment; in the centre, the huge kitchen, or living room, in which master, mistress, servants, and men all took meals together, and which consequently gave off a strong odour; while the milk room was on the left. In the kitchen fire-place was the never-forgotten boiler arrangement for heating the dairy, and near at hand the copper for boiling the milk and cheese vessels. On entering the dairy the first objects that we noticed were a pair of barrel-churns, so connected, by M. Paynel's never-failing ingenuity, that one or both could be worked by the same power. They were placed side by side, and a chain of particular make joined one to the other. Outside the house was the horse-gear, and, at any moment, by slipping off the chain, or slipping it on, one or both churns could be worked as desired. The insides of the churns were very simple, a few ribs being fixed far apart, nothing more. On each side of the apartment was a stone-built shelf, and above that again a narrow one of wood. On these were the newly-made cheeses in the tin moulds, awaiting the period for the removal to the drying-room. On this occasion, Livarots were the cheeses, for M. Paynel never makes Camembert until August, and then he continues until June 1st, when Livarots come in again. The milk-pans were of the same pattern as are in use throughout the district, and as may be seen in the various markets.

We were next taken across the yard by Mdme. Paynel, Monsieur standing at the front door and shouting out his orders to her in a most peremptory manner, and introduced to the *hâloir*, or *séchoir* (Fig. 119), which is a long apartment adjoining the farm buildings, specially fitted with shelves and nicely ventilated. Down the centre was a stand, on which were several sets of shelves, from floor to ceiling, or eight on each side. The walls were similarly fitted with rows of shelves, on which the cheeses are

laid and turned, as need be, until they are finally taken to another finishing room, called the *Cave*. The *séchoir* contained but few cheeses, and these were Camemberts, retained for consumption at home. The *cave de perfection* (Fig. 120) is a similar apartment, with one set of broad shelves, eight deep, and here the Camembert ripens, and is laid on the shelves according to its age. The ventilation is again very perfect, and, in case plenty is required, the door

Fig. 120. Camembert Cheese-making.—The *Cave*.

is in duplicate, the inner one being of fine wire, so that, the outer one being opened, the apartment is made as delightfully fresh and cool as possible.

The markets which are patronised by M. Paynel are Lisieux, Farvaques, Livarot, and Vimoutiers; and his cows produced him in one year (there were 57 of the Norman, Cotentin, and Augeronne breeds, the last fatting better than the Cotentin)

146,412 litres of milk, or 7·13 litres per head per diem. This quantity of milk made 1292 kilos of butter, and 3125 Livarot and 59,146 Camembert cheeses, which, it will be admitted, was a very valuable return. When making the Livarot, about 60 cheeses are made daily; but, in the Camembert season, 500 to 600 are made. During several months some of the cows are said to have reached 32 litres a day, and this statement has been accepted by the highest authorities; but we have no hesitation in doubting it. Much more real is M. Paynel's statement that, taking the year, the average is about 2900 to 3300 litres, or 8 to 9 litres per head. M. Paynel's method of making his cheeses we will describe presently, as we think the system cannot be too widely known in England, where the conditions of success are frequently as great as in Calvados.

Camembert.

The first cheese of this well-known name was made in 1791 by Marie Fontaine (Madame Harel), who, with her husband, took a farm in the commune of Camembert, near Vimoutiers. Madame Harel's productions were at first sold in the market-place of Argentan, but as they became known her custom increased, and in 1797 she established a depôt in the town with one Madame Trouvé. In 1813 her eldest daughter was married to M. Paynel, of Champosoult, and this couple continued the manufacture of the cheeses, receiving successive honours and medals, notably from the Norman Association in 1846.

In describing the process of manufacture, we follow that shown to us by M. Cyrille Paynel in our visit to him at Mesnil Mauger, and which has been aptly described by M. Morière, who says that the maker of Camembert must not expect to draw from his milk two profits; and if he would make a reputation which will enable him to realise the best prices, he must extract no cream from it, and only make butter in the months of May, June, July,

and August, a period when the cheeses can only be made poor and thin.

The rennet is added to the milk at a temperature similar

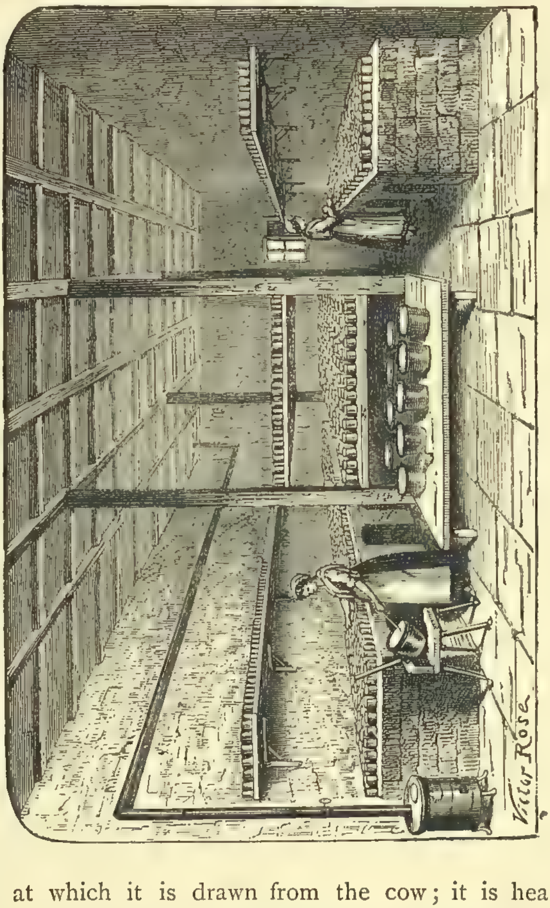


Fig. 121. Camembert Cheese-making.—Filling the Moulds.

to that at which it is drawn from the cow; it is heated in a tub, and a portion of the morning's milk is added to the milk of the previous evening. The heating is a very important matter, and in some dairies copper pipes are laid, so as to conduct hot air about them and maintain an equal temperature. The quantity

of rennet added depends upon the strength of the liquid, the quality of the milk, and the temperature, etc. In order to use a rennet of one regular strength, some makers prefer to purchase of a first-rate house rather than make their own. M. Paynel uses about 1 dessert-spoonful to 20 litres of milk, augmenting the dose in winter. When the rennet is added to each pan, the milk is gently stirred with a long spoon for two or three minutes, in order to completely mix it for coagulation. A wooden cover is then placed upon each pan, and it is left for five or six hours, according to the season; but the best test of its readiness is when the finger is laid upon the surface and the curd does not adhere. The curd is then taken out by spoonfuls and put into cylindrical white metal moulds (Fig. 122), which cost about 4*s*. 6*d*. a dozen, and which are open at both ends. These are previously placed upon the rush mats, similar to those used in making the Pont l'Evêque, upon slightly inclined tables, and which have on the lower extremity a small gutter, which carries off the whey into a receptacle below. In some cases these tables are laid with porcelain surfaces, the mountings and edges being of iron, with pipes to carry off the whey into the piggeries outside. It requires as a rule 2 litres of milk to make one cheese. When the curd has remained two days in the moulds, the cheese possesses consistency enough to enable it to be moved with ease. Then the left hand is placed beneath it, and, assisted by the right hand, cheese and mould are turned, so that the top face is placed at the bottom, in contact with the mat. The top is then powdered with fine white salt, and the cheese is left to drain until next day. At the end of 36 to 48 hours from filling, the cheeses are taken out of the moulds and salted. The operator takes them one at a time in the left hand, and finishes them rapidly and perfectly. When salted, they are placed upon the wooden shelves above the draining tables, and here they are left for two or three days, until

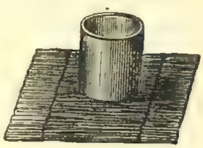


Fig. 122. Camembert Mould and Mat.

they are ready to send to the *hâloir*. At this time they are placed upon a board and carried on the shoulder to the *hâloir*, and laid upon racks covered with straw (Fig. 123). M. Paynel has made an improvement, by substituting for the straw, drainers

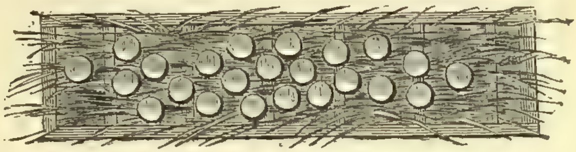


Fig. 123. Cheeses in the *Séchoir*, or *Hâloir*.

made of the wood of the broad-leaved elm, which prevents them from contracting an unpleasant taste, and at the same time keeps them of a better shape.

For the *hâloir* to be perfect, it is necessary that the cheese-maker should be able to ventilate the apartment at will; and not only must the current of air be energetic, but varied, in order that the

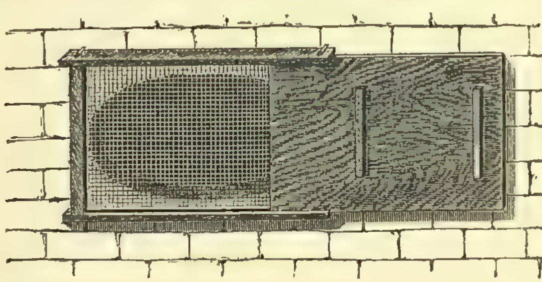


Fig. 124. Ventilator used in the *Séchoir*.

cheeses placed at different heights shall be affected. The disposition of the openings, then, is a most important item in the manufacture of the cheese, and it is in such matters that the intelligence of the maker is brought to bear. Over the openings (Fig. 124) is placed very fine perforated metal, to prevent the ingress of dust and insects. In the cheese dairy of M. Desroquettes, the *hâloir* is an apartment some 14 yards long by 6 yards wide. Upon each side are two

ranges of openings, which are 16 inches by 10 inches. These openings, of which there are 17 above and 18 below, are covered with perforated metal and provided with shutters, in the centre of which is a circular window, about 3 inches in diameter. The sun is the enemy most to be feared in the manufacture of Camembert, consequently every precaution should be taken to prevent its entrance. The duration of the cheeses in the *hâloir* varies according to the season and atmospheric circumstances, but it is from 20 to 25 days that the air is frequently renewed in diverse directions. When the weather is damp or foggy, it is necessary to hasten them and open all the windows, otherwise the cheeses to be dried remain soft, and are likely to spoil. When first taken to the *hâloir*, they are at first turned every day, and then every two days; from the third day they commence to throw up a number of brown points, and at the end of eight or ten days they are covered with a fine vegetation of white patches, leaving here and there some parts intact. This white becomes a bright yellow, then a reddish yellow. When the cheeses commence to sweat and no longer stick to the fingers, they are placed upon a tray and carried to the *cave de perfection.*

The *cave de perfection* is an apartment in which the openings are glazed and provided with shutters in the interior, in order to prevent the penetration of the sun's rays. Here currents of air are not needed, as the temperature must be very mild and the atmosphere a little humid. In the case of the maker before named, the temperature, which is constantly watched by means of a thermometer, is maintained as nearly as possible at 10° Centigrade (50° Fahrenheit). The method of paving the floor prevents too much moisture arising, which would be prejudicial to the perfect ripening of the cheeses. They are ranged, according to age, upon plain shelves in separate stages, and are sometimes placed by the side of the wall. These shelves are built so that the bottom range is about a foot from the ground, and the top only a foot from the ceiling, a little more than a foot dividing

each. The cheeses remain in the cave from 20 to 30 days, during which time they are the object of constant and most minute care. They are turned every day, or every other day, each phase of fermentation being watched, this showing its effect in the settling of the white mould, the change of colour on the surface, the formation of red spots, and the softening of the flesh.

In the factories where they make all the year round, the degree of perfection to which the cheeses are brought varies with the season. Until the middle of October the Camemberts preserve a certain firmness; but they do not then possess all the qualities which are found in the best samples, and are sold at a lower price than at an earlier season. This incomplete ripening is brought about by the high summer temperature.

When the cheeses are made, they are placed in packets in sixes, each being wrapped in paper and covered in wheat chaff, and fastened by a thread or strap of reed. They are then packed in osier baskets or in wooden cases, and despatched. Some makers prefer to wrap each cheese in paper, to prevent their sticking together in transport. The price varies with the season; during summer they often sell as low as 5 fr. the dozen, while in the best season they reach 8 fr. and 9 fr. On the average it takes 2 litres to make a cheese of 300 grammes—about 10½ oz. M. Paynel makes about 500 cheeses daily, which means 1000 litres of milk. These are sent to Paris at an average price of 8 fr. A good cow, giving 3000 litres of milk per annum, from which 1600 cheeses can be made, produces, at 7 fr. the dozen, 875 fr., or about £35. Deducting one-tenth for loss and accident, and 6*d.* a day, or 219 fr. a year, for the cow's keep, we have a balance of nett profit of 572 fr., or about £23. A good cow, then, employed in making Camembert may be estimated as worth £20 a year. There are in Calvados a large number of farmers who make from 10,000 to 160,000 cheeses per annum. At the head of this remarkable list stand MM. Paynel, Serey, and Jouenne; and there are at least fifty makers who exceed 25,000.

From the station of Lisieux at least 655,000 kilos., valued at 500,000 fr., are despatched. From Mesnil Mauger twenty-four makers sent in one year 250,000 kilos., or 12,500 cases containing 62,000 dozens, which at 7 fr. the dozen represent 434,000 fr. The various districts in Calvados are estimated to produce per annum cheeses of this variety to the value of 2,000,000 fr. In the district of Orne there are more makers than in Calvados, but they are not so important; those, however, in Vimoutiers and Gacé have doubled in number in a short time. There are in Orne about a dozen persons making from 40,000 to 140,000 cheeses a year. One result in this district is, that store beasts have been largely supplanted by cows. Some persons have stated that the cow deteriorates the value of the pasture more than fatting beasts; but a few visits to cheese farms will show how mistaken this idea is, for the dairymen have reclaimed the land much more than the graziers.

The Pont l'Evêque.

The neighbourhood of the little town of Pont l'Evêque, situated as it is between Lisieux and Honfleur, has been celebrated for its cheese since the thirteenth century, and about 1660 a poem called after the town was published in Paris, in which was a song describing the cheeses under the name of Angelots. Their form was then bizarre, some being in the shape of fleur-de-lis, others of crosses, hearts, hares, and so on. Without doubt, the name Angelot is incorrect, the ancient name of Augelot, taken from the original place of manufacture, the Valley of Auge, where the pasture is of high quality, being the accepted term. Now, however, the designation of Pont l'Evêque (Fig. 125) is recognised everywhere. There are three qualities made, these differing only in the quantity of cream contained in the milk used. The first quality is made in two ways: 1st, after milking, the *fleurette*, or first cream, is added to the new milk; 2nd,

the pure milk is used without any addition of cream. For the second quality, the milk of the morning is mixed with the milk of the previous midday and evening, these having been first skimmed. Sometimes the milk of two days is mixed with the new milk, but the result is a much less rich and delicate cheese. For the third quality, the milk of three milkings, creamed, and without the addition of new milk, is used. In autumn four milkings are often mixed, but in summer only two, because of the danger of the milk turning sour. In winter, on the contrary, the milk of five and even six days is used; but, as a matter of course, the produce is inferior in the extreme.

The coagulation is caused, as in most cheese factories and dairies, by the use of *tournure* or rennet, made from the fourth stomach of the young calf. This stomach, or *caillette*, contains an essence which is very powerful, and which is the rennet. The better it is prepared, the more valuable it is, because it becomes more and more acid. It is prepared, in fact, in various ways, sometimes by the same person, according to the quality of the cheese he intends to make. When making cheeses of whole milk after having strained it through a cloth or a horsehair sieve, the milk is placed upon the fire until it is lukewarm; the rennet is then added, in quantity according to the strength and state of the milk. No definite directions can be given as to the exact quantity of rennet to add; but whereas too little fails to coagulate, too much causes too active a separation, and gives a disagreeable flavour to the cheese. The art consists in employing enough, yet as little as possible, and this can only be acquired by practice. Having well mixed the whole with the hand, the vessel is moved from the fire, and left until the contents are properly coagulated. When the rennet is good, this happens in about fifteen minutes. As soon as the whole is set, it is cut to the bottom of the vessel with a species of wooden knife, so as to divide, as much as possible,

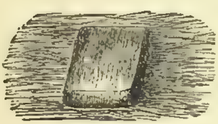


Fig. 125.
Pont l'Evêque Cheese.

the curd from the whey. It is then covered with a cloth and left for five minutes, when the curd is taken out and laid upon mats of rush or reed, called *glottes*, where it again loses a fresh quantity of whey. Next they fill up the square moulds, made of beech or ash, and leave them upon the same mats until the drainage is complete. These are turned seven or eight times in the twenty minutes following the operation, and in the day five or six times more, after being placed upon fresh dry mats of the same kind. At the end of 48 hours the cheese is taken out of the mould and salted with very fine dry salt, the white variety being preferred, as it attracts less moisture from the air. In the morning the cheese is salted on one side, and in the evening on the other, a small quantity of salt being used each time. After this the cheeses are placed in the *séchoir*, where there is nothing else but the long ranges of shelves suspended from the ceiling. This apartment is well aired by means of practicable openings in the walls. The new cheeses are laid at equal distances from each other on these shelves, and so remain for two or three days, according to the time necessary for them to dry, being turned once a day only. When they are dry they are carried to the cave, where they are placed in boxes without delay, and laid one against the other, which is supposed to hasten their transition into ripeness. While in this state of fermentation the greatest care is necessary, and they must be turned every two days, until perfectly dry and fit for a change of position, when they are stood upright, and finally placed flat, the one on the top of the other. They are at all times carefully covered with cloths, to preserve them from insects. The cheeses remain from three to four months in the cave, according to their size and quality; the soft cheeses, that is, those which contain the largest proportion of cream, remain for a less period than the hard cheeses, and fifteen to twenty days is often sufficient when they are thin. If the cheeses are preserved for a long period, and it happens that they become hard, they are enveloped in a cloth damped with whey. This

operation is made without regard to age, and the cheese regains its tenderness and is well preserved. It may be mentioned that the reproach made by many persons against the Pont l'Evêque cheese, that it cannot be preserved until the end of the spring, is not well founded. Properly taken care of, it retains all its qualities not only for a year, but for eighteen months and even two years; the essential points are to deprive it of air, and to prevent its improper contact with damp.

The cheeses from whole milk are generally made in September and October, at a period when the cows are in the aftermath and well nourished. At the fall of the leaves, these, eaten by the animals, impart a bad flavour both to butter and cheese, and it is thus more particularly in the above month that the best cheeses are made. The summer cheese, made in May, June, and until autumn, is made in the same manner, but with the milk obtained from the previous day's midday and evening milkings skimmed before using. After mixing with the milk of the morning, it is treated as before. In June when the heat has commenced to make itself felt, some makers are not particular about the evening's milk being skimmed; and in September and October, when it becomes cooler, they make cheese with the milk of midday, of the evening, and of the next morning, after having skimmed the two first milkings. This passes for whole-milk cheese, and bears preservation admirably, although it is, of course, poorer in quality than the cream cheese which it largely supplants.

The summer cheese has a tendency to harden; to prevent this a little boiling water is put into the milk when it is prepared. Water is used by some persons in the manufacture of all cheeses, but it is essential that when added it should be very hot, and that whatever the temperature of the mixture, it should be such that the hand can be held in it. In the summer the mixture must not exceed a lukewarm heat, otherwise the cheese will be too hard. In autumn and winter it should slightly burn the finger. Many persons make the first quality, sweet milk or

bespoken cheese, without the addition of water; but those who add water, warm the milk to a little above lukewarm heat, and add boiling water to the extent of about one part in twenty. For cheese of the second quality, milk of the same temperature is introduced, and 1 litre of boiling water is added to 5, 6, and even 7 litres of milk. As in summer the milk is stronger, and as the cheese which is made is more liable to harden, a little more water is used than in autumn: but it is necessary that in summer the water should be lower in temperature than in autumn, because in the latter season the milk sets less easily on account of the cold.

With regard to cheese of the third quality, the milk is not made warmer because it is older. The makers simply boil the water which is poured into it; but as old milk is liable to turn on stirring with the hand, great care is needed in adding the water, in order to bring the mixture to the temperature required without having produced coagulation. The cheese which keeps for the longest time is that which is made without water, or with sweet milk to which only about 4 or 5 per cent. of water has been added. This is only made late in the autumn, especially in the months of September and October. The cheese of the second quality, made at the same time, keeps equally well.

The cheese of the third quality, or summer cheese, must be eaten quickly, as it will not keep more than two or three months. It is otherwise as fine as the cheese made from whole milk. At the end of three weeks these cheeses are usually of a velvety blue, a certain sign that they are ripe, when they are at once sent to the country markets.

It requires 4 litres of sweet milk to make one bespoken cheese (*fromage de commande*), at 1 fr. 50 c., 5 to 6 litres for a cheese of 2 fr., and 8 to 9 litres for a cheese of 2½ fr. to 3 fr. Thus, taking English wholesale prices of say 7*d.* the 4 litres, the Frenchman makes just double by the sale of the Pont l'Evêque, or as much as the retail prices of milk in England,

which is truly remunerative, while, in addition, he has the whey for his pigs. In this way it is estimated that good cows return a profit of 350 fr. per annum.

In the ten years recorded, the quantity of these cheeses sold in the market of Pont l'Evêque varied from 150,000 dozen at the beginning of the period, to 146,000 dozen at the end, showing a slight falling off, although the price has risen materially. In the last year, the sum realised in this one town was considerably above 1,250,000 fr.

The bespoken cheese, made of whole milk, or of two-thirds of whole milk and one-third of cream, is seldom seen in the market. It reaches 30 fr. and sometimes 40 fr. the dozen, and is found almost solely upon the tables of the rich. Every year a certain quantity is sent to Paris and different parts of the world. It is well to observe that the price of this cheese is fixed not alone by its quality, but also by its thickness; for the fine samples made late in the autumn, similar to the bespoken cheese, make but 1 fr. 50 c. to 2 fr. at the most. The sum annually yielded by the manufacture of *fromages de commande* reaches 30,000 fr. Pont l'Evêque cheeses are made on all the farms in the *arrondissement*, and it is easy to find a large number of farmers, each of whom makes from 4000 fr. to 5000 fr. value per annum. The best makers are found at Saint Etienne, Glanville, Reux, St. Martin Douville, Clarbec, Surville, Pierre-Gitte, and St. Julien-sur-Calonne. If we add to the two sums already mentioned, 200,000 fr. for cheeses which do not pass through the markets, but are sent directly by rail, we get 1,500,000 fr., which about represents the value of the industry.

Livarot.

This cheese takes its name from the town of Livarot, which is the principal centre of its manufacture, and where on the market days a very large number is sold. Although inferior in

quality to the Pont l'Evêque and the Camembert, it is of all Normandy cheeses the one which renders the most service to the workmen, to whom it is meat, and it is easily preserved and transported. It is made entirely of cow's milk, and that drawn is creamed the next day and poured into large wooden tubs which are often of from 40 to 60 gallons in capacity, and then brought to the temperature which it possessed when it left the udder of the cow. When thus prepared the rennet is added, the proportion varying according to the season. In summer a dessert-spoonful is mixed with about 6 gallons of milk; in winter double this quantity is used. The rennet is usually made on the premises, several stomachs of the calf being cured together; and for each is added a large spoonful of salt and 3 glasses of water. After adding the rennet, the milk is left for one to two hours until the coagulation is complete, when the curd is broken up and laid upon rushes or a clean cloth. It is highly essential that the curd should be reduced to small cubes about the size of lumps of sugar before it is finally removed.

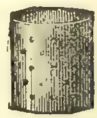


Fig. 126. Livarot Mould.

Having been left to drain for a quarter of an hour, it is placed in the circular moulds (Fig. 126), in which it is left until it has been completely drained and has attained a proper consistence. When it is warmed, this result is sometimes reached in three to four hours, but at the cost of the quality of the cheese, and it must not be left too long in the moulds; one day to four, according to the season and the temperature, are the limits which are usually prescribed. One hour after placing the curd in the moulds, they are turned upside down, and this is repeated half a dozen times before the cheeses are released. Thus drained and solidified, they are termed *fromages blancs*, or white cheeses. These are salted with the hand, and left four or five days upon the inclined tables, which are either of wood or stone, and then they are taken to the *hâloir* or the market. The *hale* or *hâloir*, is an apartment in which, by means of practical windows let into

opposite walls, a current of air is produced which has for its object the desiccation of the cheeses placed in various stages upon the lath racks, which have been previously covered with rye-straw. This desiccation follows with more or less rapidity; it takes more time in winter than in summer, and sometimes in the former season it is necessary to make a fire. Usually these cheeses are left in the *hâloir* from fifteen to thirty days, when, as in the cases of the Pont l'Evêque, they are taken to the cave. In this apartment there is not so much circulation of air, all the apertures being closed, as it is necessary that the temperature should be as uniform as possible if it is desired that the fermentation or refining process should bring the cheeses into good condition. Caves built underground or on the flank of a hill are much better than those built aboveground, where they are more exposed to the variations of temperature. The walls of the caves are made of mortar mixed with chopped hay, as the gas thrown off by the Livarot rapidly destroys those built of brick or stone. The cheeses are placed upon planks in the cave, where fires are never made. They are turned twice a week in winter and three times in summer, the attendant taking care to wet them lightly each time with pure water. If a cheese has not taken salt, it is placed in a little pan and salted afresh, or dipped in salted water. At the end of eight or ten days in the cave the cheeses are placed upon their edges upon a species of sedge—the leaf of the *Lypha latifolia*—which assists the drying process, and which is divided into strips with remarkable dexterity by women used to the work. The large cheeses remain five to six months in the cave, the others taking three or four months, according to thickness. At the time of packing for transmission to market they are coloured with annatto, which gives the somewhat disagreeable appearance so well known to visitors to the country.

As for the Pont l'Evêque, the months of September and October are chosen for making the best Livarots. In winter it requires about 3 litres of milk to make a cheese which sells at

8 fr. the dozen; in summer it takes from 4 to 5 litres to attain the same result, as in effect both curd and whey vary in the same animal, according to the season and method of feeding. The best makers say that the profit is greatest where their cows are fed upon pastures well exposed to the midday sun. It is estimated that the dairies of Livarot secure an annual profit of about 300 fr. per cow, and in some instances, where the management is first-rate and the reputation good, 350 fr. is reached.

Among the best makers is M. Barel, who in the season has as many as 1500 to 2000 dozen cheeses, all of which are regularly attended to. He purchases of his neighbours from 7000 to 8000 dozen white cheeses, which he perfects in his own cave, and in the course of a year he sells some 11,000 dozen. Many other makers iesiding at Livarot, Montviette, Castillon, and Vieux-Pont, make from 5000 to 8000 dozen. In the cantons of Livarot and St. Pierre-sur-Dive are more than 200 makers, who buy on the average some 300 dozens of cheeses for perfecting in their own caves. There are in Lisieux, Livarot, Mesnil Durand, Mesnil Germain, Vimoutiers, and several surrounding towns, nearly 100 individuals whose business it is to forward or ship these cheeses, and who are in one sense the middlemen of the trade. The total quantity forwarded by these *expéditeurs* in one year was 476 tons, or 476,000 kilos. In another year 424 tons were sent from Lisieux station, while in the same year 647 tons of cheeses not described were also forwarded. From the station of St. Pierre 56,000 cases, representing 112,000 dozen cheeses, weighing 1504 tons or 1,504,200 kilos., were sent in the same year.

The white cheeses sell at from 3½ fr. to 8¾ fr. the dozen; these make in the end 15 fr. to 20 fr., and during Lent 20 fr. to 30 fr. the dozen. Very many Livarots are consumed in Havre, Rouen, Caen, Orleans, Nantes, and Paris. Laval exports a large number, and after Paris the largest quantity is consumed in the district of Mayenne.

Among the chief markets Vimoutiers takes a great quantity of these cheeses, and in one year 110,000 dozen were sold here. Livarot is, of course, more important. In 1867 231,000 dozen were sold, at an average of 5·45 fr. the dozen. This immense sale declined to 64,000 dozen in 1870, during the war, but the price had risen to 8·50 fr.; while in 1876 it had risen again to 154,000 dozen, at an average of 7·40 fr., equal to 1,145,000 fr. In each market an official takes an exact account of the number of baskets and their contents offered for sale, so that a correct account is always rendered. At the market of Lisieux, which we visited—it being one of the oldest and best in the Department—the war made a difference on the other side; for where, as in 1867, 400,000 dozen were sold, the number rose to 500,000 dozen in 1870, and has been increasing ever since to 650,000 dozen. Here three varieties are sold—white cheese, which is eaten fresh, and is most delicious, 2*d.* each retail, or 1·20 fr. to 2 fr. the dozen; Camemberts of medium quality, from 4 fr. to 5·50 fr.; and Livarot, which varies from 9 fr. to 11 fr. the dozen. It is estimated that at St. Pierre 1000 dozen cheeses are sold in the market every week, at an average of 7 fr. a dozen. To recapitulate, we find the following totals will give an idea of the industry:

	Francs.
Market of Vimoutiers	400,000
,, Livarot	1,145,000
,, Lisieux	1,800,000
,, St. Pierre	364,000
Lisieux Station	238,000
Lisieux St. Pierre	700,000
	4,647,000

As the sum estimated in 1866 did not exceed 2,000,000 fr., the manufacture has quite doubled since that year.

Mignot.

A family of the name of Mignot have given their name to this cheese, which they made for the first time at Beuvron. Two kinds of Mignot are distinguished—the white cheese, which is made from the end of April until the month of September, and the Mignot passé, which is made from September to April.

In making the latter, the milk of the morning and of midday, or only that of midday, is creamed in the evening and mixed with the evening's milk. The mixture is warmed until it slightly burns the finger, when it is poured into earthen pots; the rennet is then added, a spoonful to each 40 litres, and it is placed near the fire during the night, from 8 p.m. until 6 in the morning, covered with a double cloth, except for a small space above. For this purpose old blouses are often used, the opening for the head of the man being left at the top, for if the pans were entirely closed the milk would become sourish. Thus the milk slowly coagulates, until, having arrived at the necessary consistence, the manufacture is proceeded with as in the case of the Pont l'Evêque, except that the Mignot is drained less than that cheese.

When the white cheese is made, the milk of the midday and the evening are warmed—the midday milk having been first skimmed—until the hand can no longer be held in it. The mixture is then placed in the earthen vessels, and covered with a cloth. Next morning they skim it, and mix it with the morning's milk, and finally add the rennet. These cheeses are very little drained; they are salted the evening of the day on which they are put into the moulds, and are almost dried without air, and despatched the next day or the day after.

The Mignot cheese, when ripe, is a rich golden colour, and resembles both the Livarot and the Pont l'Evêque in flavour; it is usually well made and good in quality, and is both round and square in form, according to the fashion of the maker. It is largely made in the communes of Ham, Pulot, Brocottes, and

others in the canton Dozulé, and in several communes of the canton Cambremer. It is sold upon the markets of Dozulé and Beuvron for Caen and Lower Normandy, Rouen and Paris. The price in summer is about 5 fr. the dozen, and 6 fr. in winter. There are made each year about 25,000 dozens, representing 125,000 fr.

Neufchâtel or Bondon.

The little Neufchâtel cheese takes its name from the town of that name in the Bray district, in the Department of Seine Inférieure. It is as well known in England as any French cheese, and finds its way into our markets in both white and ripe forms. In making the Neufchâtel, the milk is coagulated in vessels which hold about twelve quarts, the temperature being about 90°. When the rennet has been added, the pans are left from 24 to 36 hours, after which the curd is deposited in cloths, which are hung over square shapes to drain, the corners of the cloth being fixed to the corners of the shape. Next it is removed into a clean dry cloth, and moderately pressed for about 9 hours, or a little more, if the whey is not extracted. It is now nice and solid, and is formed into shape by the aid of small cylindrical moulds, and then salted all over its surface and placed on a plank in rows without touching, and carried to the cave. A strong white mould appears in a few days, and it is then ready for marketing as a new cheese. If it is ripened, it remains much longer, and is turned regularly. It is estimated that 1 lb. of milk makes a cheese, consequently a gallon will make about ten; so that, as the maker realises as a rule at least a penny apiece, he may be considered to get 10*d.* a gallon for his milk, or nearly £30 a year for a good cow. In this district, however, the cattle are not so fine, nor the pasture so rich and luxuriant, as in the Camembert district; consequently these figures are not often reached. At all events, reckoning the whey and the calf, the profits are considerable.

It would be difficult to estimate the actual value of the French

soft-cheese trade, but it is immense. In Calvados alone it reaches 10,000,000 fr. Manche is proportionately great, and several other Departments in the northern district alone reach very high figures. At all events, we believe we are under the mark in estimating that in Normandy alone it reaches 30,000,000 fr.; and yet one of our leading dairy authorities is of opinion that soft-cheese making is not worth the while of the British dairy-farmer.

The following is another description of the process of making Neufchâtel or Bondon cheese :

Neufchâtel Cheese

is usually called Bondon—*Bondon de Rouen*—and in certain localities, Bondar. These names are all derived from the cylindrical form given to the cheese. The actual size of the Bondon varies considerably, according to the time of making. When placed in the dry house the cheese is generally about 2¾ inches high and from 1¾ to 2 inches in diameter, but when ready for use—that is to say, from 4 to 5 months afterwards—it is considerably smaller, and little more than 1¼ inches in diameter and 2¼ inches high.

This cheese is used in the Department of the Lower Seine and its neighbourhood. It is rarely absent from the table of the rich, and constitutes almost the only food which the workman takes with his morsel of bread. In Rouen there are, on the average, consumed every year nearly 44 Bondons per head of the inhabitants. As each of these cheeses weighs about 3½ oz., this gives a total of about 11 lbs. of cheese per Rouennais, although Parisians do not consume more than about 4 lbs. per head. From an economical point of view, this is one of the best uses which can be made of cows' milk.

The manufacture of Bondon is, at least in the earlier stages, similar to that of fresh Neufchâtel. As soon as the milk is ob-

tained from the cows, it is taken to the farm and at once strained. The filter used for the purpose is simply a tin funnel with plated wire gauze at the lower end. This funnel is placed over an earthenware bowl, and the milk is poured through it. In cold weather the milk is immediately coagulated. In warm weather it is necessary to wait until it has cooled a little. As a general rule, the milk may be coagulated as soon as it has reached the same temperature which it had when taken from the cow. The same rennet may be used for cream cheese and Bondon cheese, although some makers employ two different rennets.

In Bray the average quantity used is rather less than ¼ oz. for 2 gallons of milk. It is necessary that the coagulation should proceed very slowly, and it is with this object that the farmers use as little rennet as possible. When once it is coagulated the milk is left alone for a period varying from 24 hours in summer to 36 or even 48 hours in winter. Then the bowl of curdled milk is carried into another apartment, called the preparatory room. Here it is put into a box formed of laths of white wood, having between them, at long intervals, their linen tied to the upright corners of the box; and it is left to drain for 12 hours. After this the four corners of the linen are unfastened, and tied together two by two, and the bundle of curd is hung by the corners in the bottom of a box pierced with holes. A board is laid on the first bundle of curd, a second bundle is laid on this, and so on till all are used. Large stones, one above the other, are placed on the last board, so as to cause a progressive pressure. On some farms the box is pressed by means of a large lever, such as is used by the Swiss for making Gruyère.

As soon as the paste is moderately firm it is well kneaded, the kneading being done with the hand on a table. This is a pity, for the perspiration causes organic products, which may later injure the quality of the cheese. It would be better to use a mill with granite stones. The paste should be oily and workable, and (if made into a ball in order to test its condition) it

should not break. If it does break, a little fresh curd or cream should be put with it, and it must be kneaded again. This inconvenience, however, will not result unless too much pressure has been used.

Dairymaids are rather fond of these imperfect coagulations, because short paste is worked more easily than long paste. As soon as the paste is sufficiently kneaded, it is formed into its proper shape. A handful of paste is put into a tin mould; it is pressed in, to make it smooth and free from air-bubbles. When done it is taken out of the mould, and the salting process is commenced. The object of this operation is to keep the cheese from going bad, but it does not prevent a certain amount of fermentation. Ordinary bay salt is used for the purpose. It is put into a cool oven to dry, and then finely powdered, either in an ordinary mortar, or in a special mill. In order to salt a Neufchâtel cheese, the operator takes the paste, as soon as it comes out of the mould, in the left hand, while in the right hand he has a handful of powdered salt. He then puts his two hands together, and by moving them alternately backwards and forwards he powders the cylindrical surface of the Bondon. The two ends are salted separately. Usually, four per cent. of salt is used in this operation, or about the sixth part of an ounce for one cheese. Nearly 200 tons of salt are used annually in Bray for salting Bondons. As soon as the cheese is salted, it is put on a deal board, placed above a vessel into which the water draining away may fall, and the Bondons are left for 24 hours.

When the cheeses cease to drip, they are taken into an apartment called the drying-room. Here, they are laid on straw. Great care is taken in seeing that the straw used is perfectly dry. It is best to use short rather than long blades of straw, so that the cheese may be in a well-aired place. Under the influence of the air, and of the salt contained in the cheese, a small flower is developed; it is the bud, and is the first stage of the refining process. The cheeses are now changed and turned

about frequently, in order that this vegetation may spread quickly and uniformly in every direction. When the lateral surface of the cheese is well covered with this velvety blueness, the cheese is put on end, and turned about backwards and forwards. In this way the Bondon gains what is called its first skin, which lasts on the average about twenty days. It is then ready to enter upon the second period of its refinement.

Neufchâtel cheese attains the completion of refinement in a cave, and it must not be forgotten, after it is put there. A damp cave would occasion a very rapid refinement, but the cheese would lack flavour; whereas a dry cave would inconveniently and considerably retard the appearance of the red colour, but the products would be of superior quality. The Bondons are not laid on their sides, as they were in the first instance, but they are put on end one above the other. The cheeses ought to remain one month in the cave. At first they are frequently turned over, but at last they are left standing on one end. The blue tinge which the Bondon had acquired in the cave will begin to change, here and there, into spots with small red points. This is a sure sign by which it is known that the cheese is ready for sale. It is usual, however, to let it remain about a fortnight longer before sending it to market. A French firm, Cheppart Frères, used to make an elaborate machine by which 1200 Bondons were turned out per hour; but it did not meet with a sufficiently large sale to pay them for their enterprise, and is no longer in the market.

According to Pouriau, the temperature of the milk when the rennet is added is 59° to 61° Fahrenheit. One of the ordinary Neufchâtel cheeses weighs about 4 ounces, and a litre of milk (1¾ pints) furnishes on the average 7 ounces of *pâte*, or cheese curd.

The Bondon cheeses of first quality, when covered with the blue mould, sell for from 9*s.* 6*d.* to 11*s.* the hundred, and the result is that a litre of milk employed in their manufacture returns to the farmer 2⅓*d.* In the year 1874 the cheese industry of the

single Department of the Seine Inférieure reached the enormous monetary dimensions of 6,750,000fr., or £272,531.

We now come to the most popular cheese of France,

The Brie.

It appears that there are nearly 5,000,000 Brie cheeses made in five *arrondissements*, the principal of which are Fontainebleau and Meaux, while the Coulommiers cheeses made upon the Brie system exceed 1,000,000 per annum, and estimating these at from 2½ to 3 fr. the kilogramme, they represent a total value of 10,000,000 fr. As in most other cheeses, there are three qualities of Brie, the fat, the half fat, and the lean or skim-milk. One of the largest Brie cheeses—that known as the *grande moule*, which measures 15 inches in diameter and nearly 1¼ inches in thickness, and which weighs 6 lbs.—requires 4 gallons of milk in its manufacture. The cheeses of the first quality, and which are sold at three weeks, realise some 50 fr., or £2 the dozen. Thus it would appear that one gallon of milk makes 1½ lbs. of cheese of the value of about 10*d.* When sold by retail the highest class of Brie realises 4*s.* the kilogramme of 2¼ lbs., while the ordinary fat cheese is retailed at 3*s.* 2*d.* to 3*s.* 3*d.* the kilogramme, and the half fat at about 2*s.*

For the following description of the manufacture of Brie, as well as for the remarks made respecting Coulommiers cheeses, we are indebted to M. Henri Cottu, a landed proprietor of considerable attainments in the Department of Indre-et-Loire, whose admirable system of dairy-farming we have had the pleasure of witnessing. The formula given has been adopted by ourselves with success, some of the first Brie cheeses made in England having taken the Silver Medal at the London Dairy Show of 1884.

The systems adopted in the manufacture of Brie and Coulommiers cheeses are almost identical, the only differences being, that the latter is less refined than the former, and that the coagulation

is somewhat differently managed. Upon the success of this depends the nature of the cheese, which, from the commencement, is governed by two elements, the temperature of the milk and the quantity of rennet used. Thus the curd is obtained rapidly in the Brie, and slowly in the Coulommiers. These two modes of operation give a brilliant, elastic, and rather firm curd for the Brie, and a heavier curd, less brilliant but more delicious, for the Coulommiers.

In making the Brie cheese, the rennet is added at a temperature of 82° Fahrenheit, and to the extent of 8-20ths of a cubic centimetre per litre of milk. Boll's rennet is used, this being considered the best and most constant in strength. To obtain the exact quantity, it is measured in a graduated pipette dividing a cubic centimetre into twentieths. The milk is strained through a muslin strainer and poured into a metal vase holding 35 quarts, and, after well stirring, it is left standing in an apartment at a temperature of 64° Fahrenheit. In spite, however, of a constant temperature, the rennet used in summer is only 6-20ths of a cubic centimetre per litre of milk. The time occupied in coagulation lasts but little beyond four hours, and the outside sign of its complete termination is the appearance of the whey on the surface of the curd, colourless and clear. The curd, which must be elastic and lively, is next put in the moulds. These are composed of two parts, formed of two circles of tinned white iron, one 4 inches in height, and the other 3¼ inches, this latter part fitting into the other. The curd is removed by means of a shallow plate of tinned iron, and the moulds filled, each set being first placed upon a straw or rush mat (Fig. 127), which is laid over a wooden board called a *plancheau*. Each cheese is then laid upon a fluted or sloping table, usually made of cement, to drain. At the end of two to three hours, the

Fig. 127. Rush Mat.

curd having drained well, sinks into the bottom mould, when the top one is removed. A clean dry mat is then laid over the cheese, followed by a clean *plancheau*, so that the mould of curd finds itself enclosed by a mat and a wooden board at each end. The right hand is then passed under the bottom board and the left hand upon that at the top, when the whole is quickly turned, the wet board and mat being gently removed, so as not to break the grain, and the cheeses left to drain in a sloping position for eight to ten hours longer. Both surfaces of the cheese will now be marked by the straws of the mat. The next morning, what is called the "crossing" takes place; a fresh dry mat and a clean dry board are taken and put upon

Fig. 128. Brie Curd Spoon.

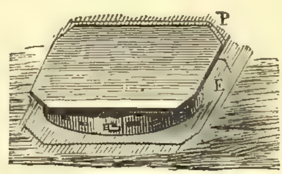


Fig. 129. Mould ready for Turning; P and E, Mats.

the top of each cheese as before, but the mat is so laid as to cross the marks made by that of the previous day. The cheese is again left to drain for four or five hours, when it is once more turned, the reverse face being "crossed" in a similar manner. After a further short period for draining, the mould is removed and the cheese taken to another inclined table, where it is simply laid upon a clean *plancheau*, this operation being preceded by the first salting, *i.e.* of the part first crossed. This surface of the cheese is carefully sprinkled with a quantity of very fine dry salt with the left hand, while the right is employed in spreading it over every portion with a goose-quill. It should not be forgotten that the apartment in which these operations take place must be kept as near as possible at a temperature of 61° Fahrenheit. At the expiration of a further twelve hours, the new

cheese is removed on to the *clayette*, a round, flat piece of osier-work (Fig. 130) a little larger in diameter than the cheese. This *clayette* is laid upon the top of the cheese, when the whole is turned as before, and the wet mat and board are removed. It is then taken to the drying or ripening room, where it is salted upon the other side, after which it is laid upon the shelves to dry, chiefly by means of the light currents of air which are encouraged to pass through the apartment. A fresh dry *clayette* is given to each cheese morning and night. Upon the second day a white silky mould appears in patches upon the face of the Brie, and when this has become general upon both sides, the cheese is taken to another apartment, where the air is regulated according to the temperature of the season, and either to hasten or retard its development into the blue or advanced stage. Here the cheese is placed upon another dry mat, which is laid on the *clayette*, and turned only once in 24 hours, the mat being changed each time. At the end of a month it has become blue, and should at once be sold, although many merchants who have a ready sale for much more refined cheeses, put them into the cave for further ripening. Those who have eaten the Brie, but more particularly those who have made it, will understand the necessity of selling it just at the right moment, for it is never so good and consequently never so profitable at any other time.

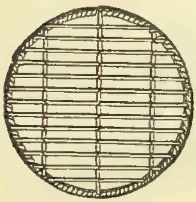


Fig. 130.
Clayon, or Clayette.

The engraving of the cheese-room at *Maison Du Val* shows the sloping shelves upon which the cheeses are placed. In Fig. 132 is shown the system by which the cheeses are drained without the necessity of laying them out separately. Five moulds of curd are set one upon the other, but, to facilitate proper drainage, the top mould A, with its board *p*, are lowered and placed upon the table at A′. The mould is then slightly raised to a height of $\frac{1}{8}$ of an inch to permit of the whey which has been

enclosed at the bottom running off. The next mould B, and its *plancheau q*, are then removed in the same way and placed at B′,

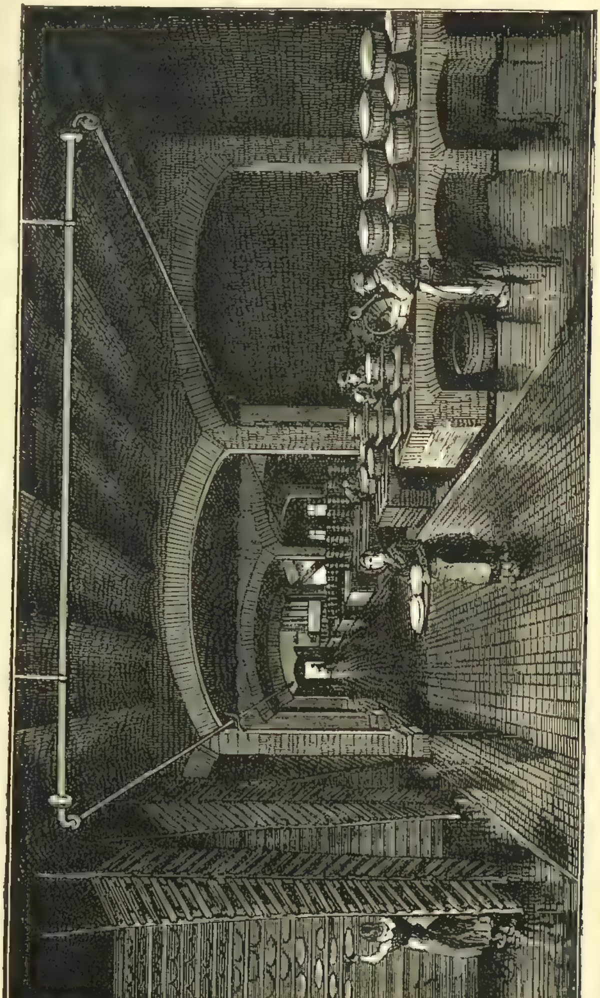


Fig. 131. Brie Cheese-making at Maison Du Val.

and so on to the end. Fig. 133 shows the arrangement of the moulds of curd as adopted in some dairies at the time of salting

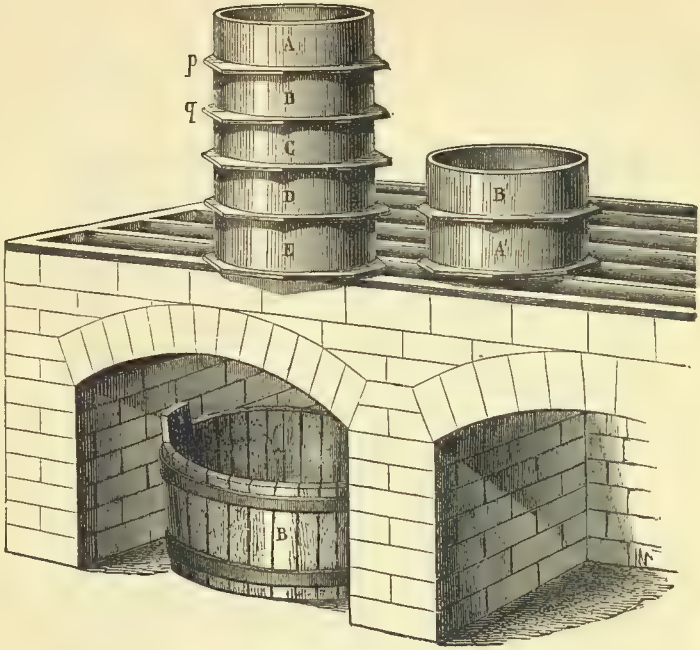


Fig. 132. Brie Draining-table.

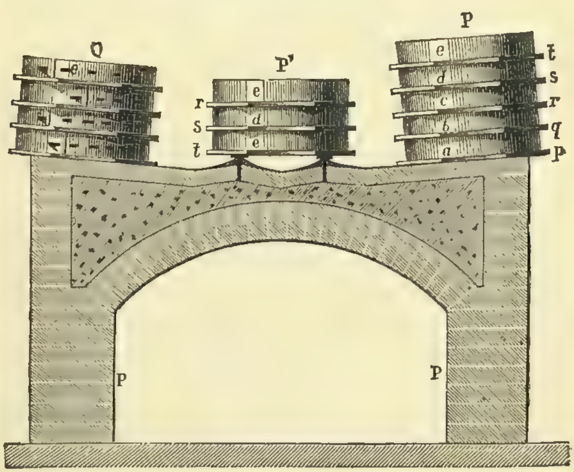


Fig. 133. Brie Draining-table (section).

and first turning; thus some of the piles are placed (P′) upon the two iron T pieces in the centre, while the others (P and Q) are slightly inclined at each side. In two or three hours the top mould *e*, and board *t*, from the pile P, are taken, and the mould removed. The cheese is then turned on to another board, which must be quite dry, salted upon its face and sides, again covered with the mould, and placed as shown in the centre at the bottom of P′. The second mould *d*, and its board on the pile P, are similarly treated, and removed into the centre, and so on as before. It will be noticed that in this case the moulds are different in form—they are termed *éclisses*, and can be opened by a buckle at the side, a system which some makers adopt.

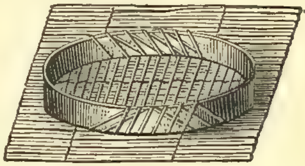
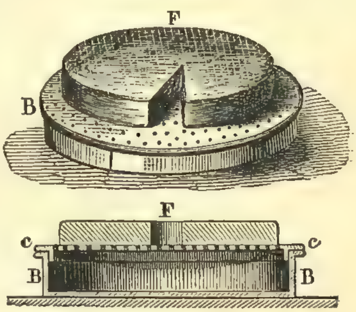


Fig. 134. Mould used for "Fromage Blanc," or *façon* Brie.

It is the custom among some milk-dealers of Paris when overburdened with milk to make cheeses resembling the Brie, which they call *façon* Brie. The mould and mat used for the curd are shown in Fig. 134. These cheeses (F) are generally sold new, and are cut by the retailers as seen in Figs. 135 and 136, but, not being thoroughly drained, they are placed upon a white-metal draining-stand (B).



Figs. 135 and 136. Façon Brie Cheese.

Pouriau gives the following data, showing the time occupied in many dairies in the manufacture of the Brie cheese:

Arrival of the milk, 5 a.m.

Heating and filling, 5 to 6 a.m.

Addition of rennet, partial skimming, coagulation, 6 to 9 a.m.

Manipulation of curd and drainage, 9 a.m. to 3 p.m.
Putting in moulds, 3 to 5 p.m.
Removal to drainer, 5 a.m.
First turning and salting, 8 a.m.
Second turning and salting, 3 p.m.
Remains upon the shelves in the cheese-room, $4\frac{1}{2}$ days.
Remains in the drying-room (*séchoir*), 8 days.
Remains in the cellar for refining, 15 to 16 days.
Total, 30 days.

COULOMMIERS.

In making this delicious cheese it is necessary that the apartment in which the operations take place should not exceed 64° Fahrenheit. The rennet, to the extent of $1\frac{3}{20}$ to $1\frac{1}{2}$ of a cubic centimetre per litre, is added to the milk at a temperature of 77° Fahrenheit. We prefer to give the French measure, which is, perhaps, more exact than could be obtained by the ordinary system adopted in this country.

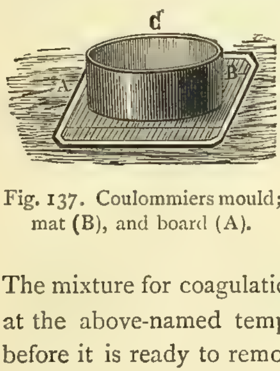


Fig. 137. Coulommiers mould; mat (B), and board (A).

The mixture for coagulation is allowed to remain in the milk-room at the above-named temperature of 77° Fahrenheit for 36 hours before it is ready to remove into the moulds. At the end of this time it will be found heavier and less elastic than that of the Brie, and it is ready when the whey is seen clear and bright at the top. The mould used (Fig. 137, C, which also shows at A and B the mat and board) is 7 inches in diameter, and there are two to each set, as in the case of the Brie, the top fitting on to the bottom. The remainder of the system of manufacture closely resembles that of the Brie in its first stages. The Coulommiers cheese can be eaten with great relish at the end of from 8 to 10 days, whilst the Brie at the same period would be rough and chalky in texture. M. Cottu thinks that the principal points in the manufacture of a soft cheese, more

especially where it is consumed by persons who are not absolutely fond of a high flavour, are, a relatively low initial temperature, a small quantity of rennet, and a prolonged time in coagulation.

The Géromé.

This cheese, which is made in the mountains of the Vosges, more particularly in the canton of Gérardmer, from which, by a corruption of the word, it takes its name, is the principal feature of the agricultural system of this district of France. In the year 1873 the annual production in two *arrondissements* was 4,750,000 kilogrammes, representing a value of 3,750,000 fr., or over £190,000.

The Géromé cheese (Fig. 138) is largely consumed in Paris when it is ripe, and it would be difficult to mention any variety which is more delicious at this particular period. It is a soft, round cheese, varying in weight from 4 lbs. to 8 lbs., and is sometimes made with the addition of aniseed. The milk is set to curd as it comes from the cow, and is placed in a deep copper vat holding some 45 quarts, when it is covered with a wooden lid, in the centre of which is inserted a cup-shaped funnel, to the bottom of which is attached a cloth for straining. When this is not used, a small disc is drawn over the hole. The rennet is immediately added, its quantity varying according to the temperature and its strength. It is necessary that in half-an-hour the whey should be divided from the curd with a ladle, and the vat re-covered. In another half-hour the separation is continued with the aid of a copper strainer, 12 in. by 4 in. in size. When the curd is divided into pieces about as large as a small nut, it is taken out and placed in wooden cylindrical moulds, of from 5 in. to 9 in. in diameter. Two moulds are used for each cheese, the one being fixed into the other, which is somewhat larger in diameter and has a number of holes pierced in the

Fig. 138. Géromé Cheese.

bottom. The total height of the two when fixed is from 14 in. to 16 in. Here the curd drains so completely that at the end of 12 hours it will have sunk into the bottom and larger mould, so that the top one can be taken off. The cheese is then removed into another mould of the same diameter as the bottom one, turned, and put upon the shelf to dry further. After 6 hours it is again turned, and this turning is continued twice daily for the two following days. As it drains off, the whey is collected into a receptacle especially placed for the purpose. The temperature of the room in which this operation takes place should be from 59° to 64° Fahrenheit. The cheeses are next salted, and for this purpose are stood upon small boards made of beech, upon which layers of fine salt are sprinkled. The surface of the cheese must be well salted, and the operation repeated every three or four days, care being taken that it is turned each time. This turning is continued twice daily for three days after salting, and the surfaces of the cheese are each time slightly moistened with tepid water. When sufficiently dry on the crust, they are removed to the *séchoir*, or drying-room, about an ounce of salt having been used in the salting process. In this apartment the cheese-shelves are built one above the other, so that large numbers of cheeses can be kept in a small space and well cured, providing the temperature and aëration are complete. In summer the process of ripening is frequently conducted in the open air, the cheeses being protected with cloths to keep off flies and the sun; but during the other parts of the year a specially prepared room is invariably used. When thoroughly dry they are removed to the cave or cellar for the completion of the process, and here they are very carefully managed. This cave must be in good condition, with a draught of air passing through it; but if the temperature is too low the cheeses crack and lose quality. The time they remain here is determined by the season and size of the cheese, the maker judging this for himself. The largest, however, are usually kept from 3 to 4 months. While in this com-

partment they are often turned, and washed with tepid water slightly salted, and daily examined to see whether they are sound. When the coat assumes a brick-red colour, and is sufficiently firm to yield to the pressure of the finger, they are ready for market. A good Gérome is firm on the surface, rich and oily, and has a few small holes in the interior, while inferior makes, like badly made Gruyères, have numbers of large holes, are fragile, easily crumbled, and sometimes soft and pulpy in consequence of the whey not having been properly extracted from them.

On the average, about 6 to 7 quarts of milk are necessary to make a skim-milk Géromé cheese of 1 kilogramme (2¼ lbs.) in weight, for they are made from poor as well as from rich milk. When aniseed is added, which is frequently the case, it is incorporated with the curd when the latter is put into the moulds to drain. The flesh of old aniseed cheese usually has a greenish tint which resembles that of the Roquefort in appearance. In the Vosges district each cow, as a rule, furnishes some 260 kilogrammes of cheese, or about 5¼ cwt.

In commenting upon this important manufacture, Pouriau urges that improvements may be made by feeding the cattle with richer food, by using rennet of a fixed quality, and adding it at one regular temperature, and by more completely dividing and draining the curd in an apartment which should be maintained at a temperature of from 50° to 64° Fahrenheit. He thinks, also, that the cheese should never weigh above 4½ lbs., when the ripening would be more complete and expeditious; the salting should be more carefully conducted, and the salt measured. The cheeses should be dried not only at a certain temperature, but by the action of a current of air which can be varied at will. Greater attention should be paid in preserving them from the attacks of flies, whose eggs are the cause of the development of cheese-mites, which do so much damage to a soft cheese. And, lastly, that the caves should be healthy, neither too dry nor too humid, and exclusively used for refining or ripening.

Mont d'Or Cheese.

A considerable trade was done in this popular cheese fifty years ago in the district of Lyons, but it has now lost almost all the importance it had acquired in that part of France. It is, however, largely made in the Departments of Oise, Rhone, Isère, and Ain, the Oise alone producing over 400,000 cheeses annually. In the year 1879, the Mont d'Or was sold in the Paris markets to the extent of £13,000, the usual price being from 4*d.* to 5*d.* per cheese, those of extra quality called *Mont d'Or de Lyon*, and in which there is occasionally a little milk of the goat, realising 6*d.* In the manufacture of this cheese there is one important difference which is not common in the manufacture of others, for the rennet is added to the milk at a more elevated temperature than is usually adopted, while the cheeses themselves are washed in sea-salt, which materially prevents the development of an objectionable surface-growth, contributes to their special flavour, and places them in a condition for refining different from that occupied by the Brie and many of the cheeses of Normandy.

The milk used in the manufacture of the Mont d'Or is drawn from the cows twice daily, at 8 a.m. and 3 p.m. It is immediately poured into a tinned-iron strainer suspended in the centre of a large vessel made of the same metal, and which contains 100 litres, or 27 gallons. From this it passes through a tap at the bottom into the two-handled earthenware vases which are used for the curd. These vases hold 10 litres, or about 2½ gallons each, and the rennet, to the extent of a spoonful and a half in summer and two spoonfuls in winter, is poured in before the milk is drawn into the vases. This process complete, the vases are ranged upon a shelf where they stand for two hours, when the coagulation is generally effected. The curd is next broken with a spoon and removed into the tinned-iron circular moulds, which hold about 1 litre each, and which

are placed upon mats to drain in an apartment of which the temperature is not less than 68° Fahrenheit. The moulds are

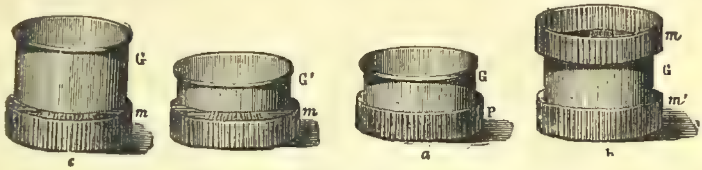


Fig. 139.

of two sizes; the larger (G) are used for the first reception of the curd and are from 3 to 3½ inches in height and 4½ in diameter, the small moulds are of the same diameter but only 1¾ inches high. The mat (*m*) is of peculiar construction; it is made of chestnut or pine bent into a circular or hooped form, while over the whole surface of the wood rye-straw is bound in two layers which are at right angles to each other. The mat is 5¾ inches in diameter by 1¾ inches in height. The draining of the cheeses principally takes place upon a stand, called an *égouttoir* (Fig. 141). The shelves upon which they are stood incline slightly downwards, in order that the whey may run off into the receptacle (E) which is shown beneath them. They are also grooved down the centre, and a number of smaller grooves run into the long one (O), and so carry off the whole of the whey as it drains from the cheeses. These shelves and stand are easily made, consisting simply of four wooden uprights (M), a number of cross pieces (*t*), upon which the shelves rest, and the shelves themselves. The end view of the set is shown in Fig. 140. Their size is given in metres and centimetres, and will be seen on reference to the engravings. It will be noticed that the rests, as shown in Fig. 140, are double the width of the shelves which lie upon them, and this greater width is necessary to facilitate the work. When the shelves are filled with newly-made cheeses the whey slowly filters between the straws of the *paillassons*, or mats, runs down the grooves, and falls into the vessel as stated above. When the moulds have been filled between two

and three hours, the cheeses are turned, but as they are extremely tender, it is necessary to use very great care in the operation.

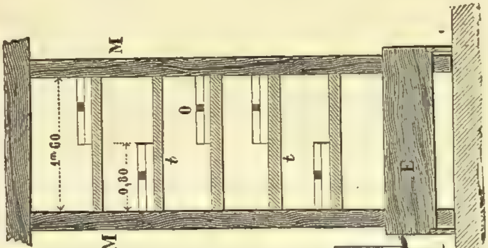


Fig. 140. End View of Shelf.

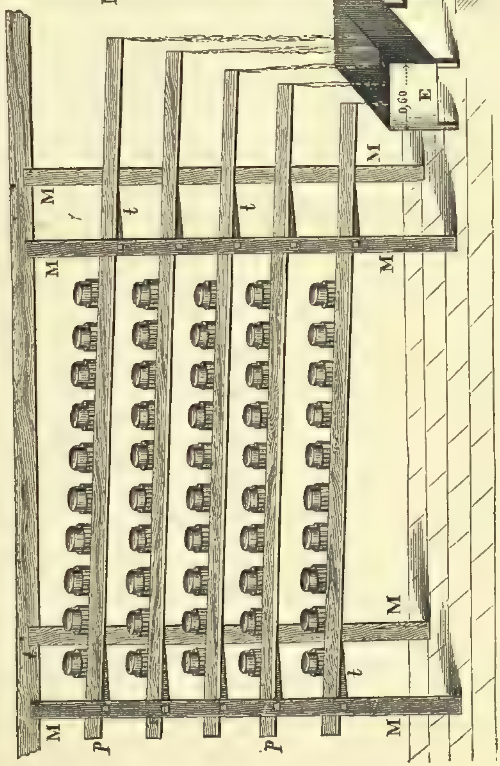


Fig. 141. Mont d'Or Cheeses set to drain.

The attendant who conducts it takes a *paillasson* (Fig. 139, *b*), places it upon the mould containing the curd, and then, with his right

hand in the centre of the *paillasson* at the top (m), and his left hand sustaining that at the bottom, he turns the whole rapidly, when it presents the appearance as seen in Fig. 139, *c*; and so the cheeses are continually turned every two or three hours, dry *paillassons* being used every time. At the end of 12 hours from the time the curd was placed in the moulds, the cheeses can be removed from the large into the small ones. In performing this part of the work the cheese-maker slides his right hand between the cheese and the bottom of the *paillasson* (Fig. 139, *c*), lifting at once the cheese and the mould, while with his left he removes the latter and substitutes the small mould, into which the cheese easily slides. A clean *paillasson* is now placed upon the new mould, and the operation of turning is performed as before. The mould

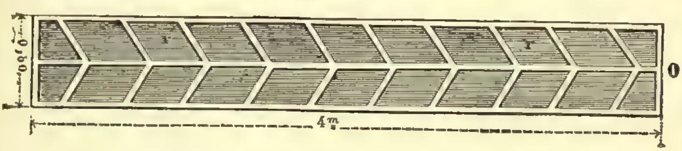


Fig. 142. Mont d'Or Draining-shelf.

and the cheese within then rest upon the *paillasson*, as seen in Fig. 141, and the draining of the whey continues. The cheeses are next taken to the *séchoir*, or drying-room, where they are laid upon rye-straw, which is disposed about the shelves, these being of lath instead of solid wood. Here they are of course out of their moulds. The *séchoir* must, as in other cases, be well aërated, and it is necessary to be able to establish a good current of air at will. The cheeses are now turned over every few hours, and each time they are moistened with a solution of sea-salt. By this means their coat changes to a rich yellow colour, at the same time the *pâte* becomes more or less creamy in the interior. During summer the ripening process takes 6 to 8 days; but in winter, 15 days, and even more, are required. A litre of milk is supposed to furnish, on the average, one cheese; and seven cheeses weigh about 1 kilogramme of 2¼ lbs.

Void.

This is a square cheese, which in its flavour and substance much resembles the Limburg of Germany. It is principally made in the Department of the Meuse, the annual production in the chief districts being estimated at about 1,800,000 lbs. Great importance is attached to the proper use of the rennet, which is added at a temperature of 95° to 98° Fahrenheit. The quantity must be just sufficient to make the cheese sufficiently firm, and yet prevent the loss of rich curd by drainage during the refining process. The separation of the whey is generally effected by cutting the curd into pieces with a wooden knife and then placing it into tinned iron vessels (Fig. 143), which are perforated to permit of the proper draining of the contents. When placed in the moulds, the cheeses are turned five or six times during the first 8 or 12 hours, after which they are salted with fine salt. In 10 to 15 days after first entering the moulds, and when sufficiently dried by being placed upon the cheese-stands, they are taken to the markets in boxes, holding about 45 lbs. to 65 lbs. each, and there sold to the wholesale dealers, who, buying them in their comparatively new state, generally perfect them themselves. To this end they place several boxes in a cave, side by side, wash the contents at first every two days with salt water, and afterwards every eight days, care being taken that each cheese is thoroughly dried before being replaced into the box from which it was taken. They thus take a reddish-yellow colour, and, when ripe, are considered very good. In the Canton of Void the ripening process takes nearly six months to complete; the cheeses being about 1 to 1¼ inches high, and worth 1*s.* 2*d.* to 1*s.* 5*d.* the kilogramme (2¼ lbs.).

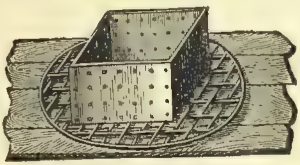


Fig. 143. Mould and Clayette used for Void Cheese.

Suisse, or Double Cream Cheese.

These cheeses are not, as supposed, made of whole cream, but of new milk, to which a small quantity of cream is added to the extent of 5 parts to 32. The rennet, ⅓ of a cubic centimetre per litre, and of the best kind, is added to the mixture at a temperature of 54° Fahrenheit, but it is preferable to previously dilute the rennet with ten times its volume of water. Coagulation is slow, occupying at least 20 hours, but to obtain the best result this is indispensable. The mould used for draining the curd is provided with a bottom which is pierced with holes. The curd is

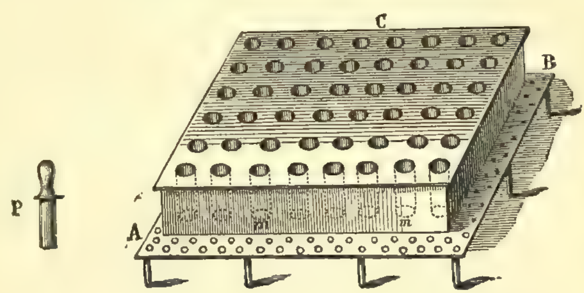


Fig. 144. Cylinders used in making the "Suisse" Cheese.

placed within in layers, each of which is enveloped in a cloth and covered with a small piece of wood fitting the mould. A slight weight is sometimes added to the last in order that the draining may be complete in 16 to 18 hours. After this the curd is taken out of the moulds and a quantity of cream worked into it by the hand, when, having arrived at a proper consistence, it is left for an hour to dry. The cheeses are next put into the moulds, and some makers, especially women, are so rapid that they can mould from 120 to 150 dozen per hour. The case (C) shown in Fig. 144 is sometimes used. It is made of iron, and encloses a large

number of cylinders the shape of the cheese (*m*), which rest upon a table below which is pierced with holes (A, B). A small piece of paper is wrapped round the *bandelette* (*p*) and introduced into a cylinder, and when all are furnished with their paper linings they are filled with the curd, which rests upon the table below, and drains until it is fit for removal for further drying and refining, or sale in its fresh state.

The Gervais, or Little Suisse.

The chief features with regard to this popular little cheese are that it is eaten as a rule within 24 hours of its manufacture, and that the rennet is added to the milk at a temperature of 64° Fahrenheit, to the extent of from a half to a twentieth of a cubic centimetre per litre.

Cream Cheese.

The cream cheese known in Paris and other large French cities, is made by placing a quantity of curd into a round strainer, which is stood within an earthenware vessel a little larger in size, the diameter of which, within 2 inches of the bottom, is less than the bottom of the strainer. Into this the whey drips. When the curd is fit, it is mixed with a small quantity of cream, and afterwards placed in a muslin cloth and laid in the heart-shaped osier-work shown at Fig. 112. Cream cheeses are frequently made in France from cream which has been enveloped in a linen cloth and buried for 12 hours in the earth. It is also frequently hung in a similar cloth until, by draining, it has become somewhat solid, when it is removed into a mould for further drainage. The cheeses are generally eaten quite new.

St. Remy.

In the manufacture of St. Remy cheese the milk and rennet are added together at a temperature of 95° Fahrenheit, the quantity of the rennet used varying from 10 to 12 grammes per 100 litres of milk. Both new and mixed milk are used, according to the practice of the maker. It is usual for the curd to be formed in the space of from 20 to 25 minutes, but in case it is not, a small additional quantity of rennet is added to the mass, without, however, again warming the milk. When sufficiently firm, it is cut or broken to pieces with a utensil employed for the purpose to assist the separation, and is then left for half-an-hour. The curd is next placed within the moulds, which are ranged upon a sloping table until the expiration of 6 or 7 hours from the time the cheese-making operations commenced, when they are turned and left to drain until the following morning. Salting then takes place for the first time, and again the moulds are turned and allowed to remain for a further 24 hours. The contents are then again slightly salted, and when comparatively dry they are placed upon small wooden plates or dishes, and removed to the shelves, being turned twice or three times daily, and the plates moistened at each turning. In case the cheese is at all hard, it is washed with the aid of a little tepid water and a brush. When the draining is complete, and the cheeses have become dry, they are taken to the cave for refining. It is usual, however, at all seasons of the year, before removing them to this apartment, which must be particularly cool, to pass them through a quantity of pure and fresh water. In the cave they are washed twice weekly at the very least, during the summer months, every particle of mouldiness being removed as soon as it appears, although as the cheeses ripen this operation is not so necessary.

The above is the system adopted at the cheese-making *Établissement de St. Remy*.

St. Marcellin.

This cheese is made from unskimmed goat's milk, and takes its name from the district in which it is manufactured. The cheeses weigh from 4 oz. to 4½ oz., and if eaten in their fresh state must be consumed within 24 hours. In the summer season they are considered very delicious, and are then termed cheeses of the third quality. The rennet used is generally made from calves' vells and white dry wine, but there is no definite rule upon this point, nor, indeed, is there with regard to the quantity employed, for as each farmer makes his own, the strength and quantity must necessarily vary. Care, however, must be taken not to use too much, or an acid taste will be imparted to the cheese. It will therefore be seen that practice is essential before a first-class cheese can be manufactured. In the winter season the milk is heated before the operations commence, but not in summer. The milk, when curdled, is placed in goblets or mugs of about two pints capacity, and which are perforated over their entire surface. Here the curd drains, and when it is sufficiently firm so as not to lose its form it is at once salted, taken out of the moulds, and placed above a layer of rye-straw upon a shelf in a well aërated and sheltered apartment provided for the purpose. Here the cheeses are salted and turned once a day in hot, and once every two days in cold, weather. Cheeses of the second quality are sent to market as soon as they commence to dry, when the crust assumes first a yellowish, and then a blue colour. Those, however, of a more perfect description are placed upon straw within a closed apartment in a cellar, and partaking, first of a blue, and then of a yellow mould, become what are known and recognised as cheeses of the first or best quality. To make good St. Marcellin cheeses, cleanliness throughout every operation is an essential qualification.

It may be mentioned that those of the second and third qualities are sometimes made from unskimmed cow's milk, and from goat's milk with which twenty-five per cent. of cow's milk is added. As, however, the pasturage from which the St. Marcellin cheeses are manufactured is quite peculiar to the district, it is really doubtful whether we can, in this country, make a cheese which can compare with the article as produced in France.

The above is the system adopted by M. Louis Bonnet, a famous exhibitor of St. Marcellin cheese.

Hay Cheese.

In the district of Bray this cheese is made as follows: Fifty litres of skim-milk are poured into a vessel standing upon a clear fire, and it is then heated to a temperature of from 79° to 86°, according to the season of the year. It is next poured back into wooden buckets, which hold 13 gallons, when two table-spoonfuls of weak rennet are added. The milk is then covered, and at the

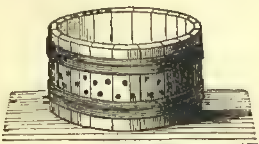


Fig. 145. Wooden Skim-milk Cheese Mould.

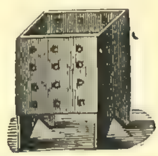


Fig. 146. Metal Mould used for Skim-milk Cheese.

end of an hour coagulation is complete. The curd is sometimes broken up with the hands, but a wooden knife is preferable. After cutting, the curd is left to itself for 20 minutes, when the whey which has drained is poured off. The curd is afterwards well worked with the hands, in order to expel a fresh quantity of whey,

after which it is put into the mould called a *casserette.* This article is circular, 11¾ inches in diameter at the bottom, 13¾ inches at the top, and 7 inches in height, and is pierced with small holes to permit of the draining out of the whey. As the curd is being placed in the mould it is strongly pressed with the hand, and energetic pressure is continued until it is full, and the cheese has become comparatively firm. It is afterwards taken out of the mould and introduced into a wood circle called a *cliché*, of a similar diameter, but less in height, and in this it remains for two days. Having stood to drain for this period it is well salted and placed in the *hâloir* to dry, being turned every day for a week. At the end of three weeks it is quite dry and ready to be taken to the cave, where it is enveloped in a wisp of aftermath and laid upon the earth, three or four cheeses being placed one upon the top of the other. The whole are examined once a week, turned, and removed according to their texture. They remain in the cave for six weeks in summer, and three months in autumn and winter, after which they are ironed and bored in order that their quality may be ascertained.

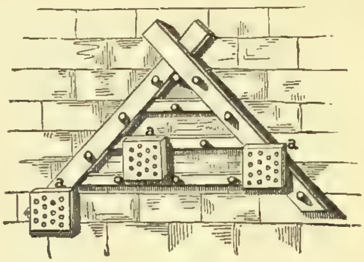


Fig. 147. Cheeses hanging to drain.

There are, in addition to those described, the following well-known examples of skim-milk cheese, which are largely consumed in the north of France, viz., Larrons, Marolles, and the Tuile de Flandre.

The moulds shown at Figs. 145 and 146 are among others used in skim-milk cheese-making. Fig. 147 shows somewhat similar moulds as they are hung up in the cheese-room to drain.

MARBLED OR VEINED CHEESES.

Among the principal Continental cheeses consumed in England are the Roquefort and the Gorgonzola, both of which are veined

Fig. 148. *Penicillium glaucum.*

or marbled in their flesh with a bluish-green, somewhat similar to our own Stilton. This remarkable growth, which is stated to be

fungoid in its nature, is known to botanists as *Penicillum glaucum* (Figs. 148 and 149). According to MM. Mussat, Pouriau, and Bourgeois, this mould commences by the development of the mycelian tubes (*m*) from which the branches (*r*) are produced. From each branch others are thrown out, until the ramifications are spread

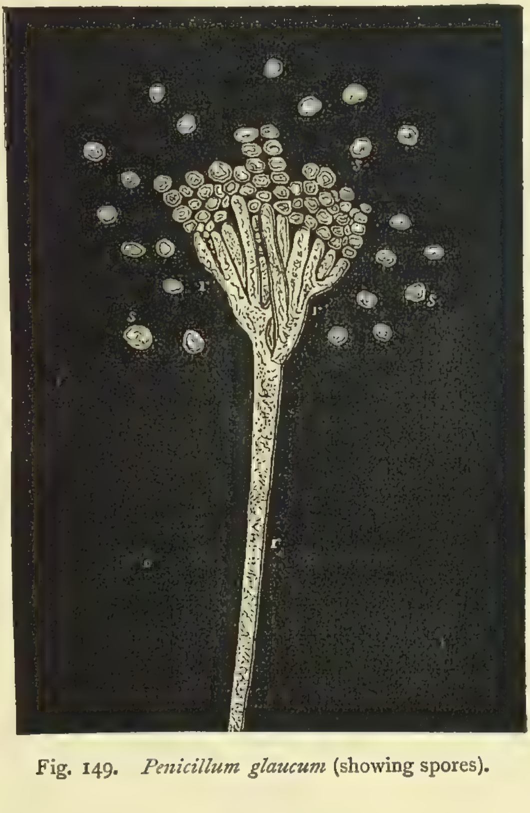


Fig. 149. *Penicillum glaucum* (showing spores).

through an entire cheese. The spores (*s*) are detached and form the basis of further growths of penicillum. Light develops the penicillum mould, which is at first white, afterwards light-blue, and lastly a dark blue, although it is sometimes black, but M. Mussat

has shown that the black fungus is dead and partially decomposed. The development in darker and humid cheese-rooms, however, is more of a dark green-blue, and where there is an excess of moisture and too great an absence of air, it is darker still, sometimes black.

In from two to three weeks after making, the marbled blue mould covers a cheese which has been properly salted. The skin of the cheese will, however, often change colour to a light yellow and afterwards to a darker yellow, while the cream-like liquid within, which has had its effect upon the colour of the

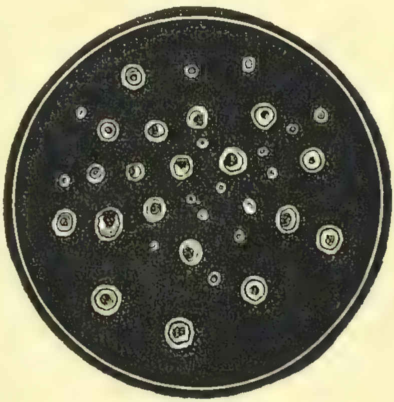


Fig. 150. Mature Fungi.

surface, gives rise to a new fungoid growth, which under favourable circumstances covers the cheese in the course of six or eight weeks. Another development of mould which is found upon many varieties of soft and partially soft cheeses which have been some time ripening takes a bright red colour, and this is owing to the *Oidium aurantiacum* (Figs. 150 and 151). The illustrations show the development of the fungus and the separation of the spores, and the same spores in their mature state. The most celebrated of these marbled cheeses are, in addition to the above-

named, the Gex, the Septmoncel, the Sassenage, and the Mont Cenis.

The Roquefort cheese, being made from sheep's milk, does not enter into the economy of British dairying, and we therefore forbear to detail the system of manufacture, which is, perhaps, more complicated than that of any other branch of cheese-making. We may, however, mention that the blue grain which is so much esteemed is caused by the admixture of the crumbs of mouldy bread at the time the curd is put into the moulds. This bread is specially prepared from wheat and barley-flour, to which

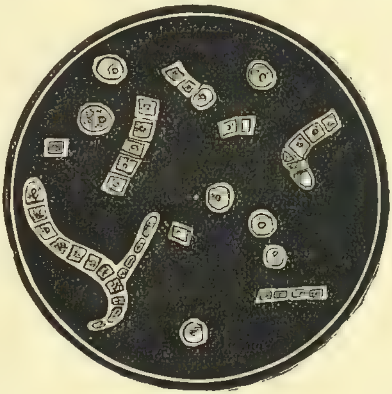


Fig. 151. Cheese Fungus (*Oidium aurantiacum*).

vinegar is sometimes added. The milk of the evening is scalded, and skimmed the following morning. It is then mixed with the morning's whole milk, heated, and the curd formed by means of rennet. It is then cut, strained, worked by hand, and placed in the moulds, which are perforated, the ground mouldy crumbs being placed between the layers of curd. The Roquefort is refined in caves, where it is laid upon its edges in straw. In some cases the apartments in which the cheeses are made are supposed to be impregnated with the germs of the peculiar fungoid growth

not only of the Roquefort, but of the othei cheeses above named. New buildings, however, offer difficulties in this respect, and the phenomenon is introduced as far as possible, but it often happens that the cheeses remain some months before the required mouldiness commences within.

The returns from the Roquefort cheese industry have now reached 20,000,000 fr. per annum, and the cheese made exceeds 1,000,000 lbs. in weight. Sold by retail in France, the choicest makes reach 3*s.* 9*d.* the kilogramme, and retail 300 fr. or £12 the 100 kilogrammes, about 220 lbs. The illustration (Fig. 152) shows an apartment in the factory of the Society of Roquefort Cheese-makers.

The machines shown in operation are known as the *Brosseuse* and the *Piqueuse*: the former is used to brush the surface of the cheeses, and the other, which is furnished with a number of fine steel needle-like points, is intended to pierce them in order to assist the development of the green mould.

Journiac.

This cheese is manufactured from the milk of the cow, and in appearance resembles the Roquefort. The milk, when it is received from the cow, is poured into a large wooden pan, which is usually made of fir, and capable of holding the yield of 100 cows. It is then taken to the cheese-room, where the rennet is immediately added. After the separation of the whey, the curd is placed in tinned iron moulds to drain for some three or four days, when it is afterwards carried to the cave, the temperature of which is 77° Fahrenheit, and carefully attended to by special *employés*. Each cheese is here turned daily, and sprinkled with a quantity of very fine white salt. Subsequently they are removed to other caves of a much lower temperature, and through which strong currents of air pass. They are here

placed upon their sides, daily examined so that all fungi may be removed as soon as they appear, and pricked to the centre with needles, the object being to bring into contact with the air a powder composed of wheat, barley-meal, and rye, which was placed within the body of the cheese at the time the curd was put into the moulds. This powder, when properly made, gives rise to the formation of a fine blue mould in the interior of the cheese, and causes it to be classified as cheese of the first quality, providing, of course, the flavour is equally satisfactory. The cheeses are generally ripe at the end of two months, when they are despatched for sale in cases holding a dozen in each.

We are indebted for the above description to M. de la Force, of Journiac, whose farm is situated about 3,300 feet above the level of the sea.

Mont Cenis.

The manufacture of this cheese is chiefly conducted at an altitude of about 6,000 feet along the Mont Cenis plateau; but it has also become quite an industry in Maurienne and the district of Valloires. On very many farms the cheese is made from a mixture of the milks of the cow, the ewe, and the goat, but in Maurienne the makers prefer to use cow's milk only, the other milks giving to the cheese a dry and somewhat unsavoury quality. The milk of the evening, previously skimmed, is poured into a large kettle with the milk of the morning, the whole being raised to the temperature it possessed upon leaving the cow. The cream which has been taken off the evening's milk is then added, together with the rennet. Next, the curd is cut as soon as possible, drained and placed in a wooden receptacle, where it remains for 24 hours. On the morrow, the same preparation is undergone by a fresh quantity of milk, and a third of this latter "cheese," still warm, is added to two-thirds of the former, a

quantity of salt also being added in proportion to the size of the cheese. The whole is then well kneaded, broken into pieces,

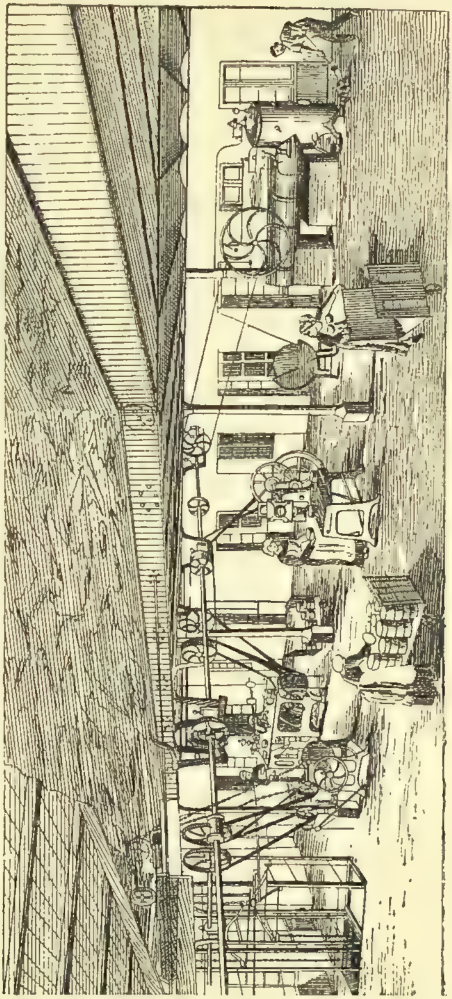


Fig. 152. A Roquefort Cheese Factory.

and two-thirds put into the moulds, which are cylindrical in shape and provided inside with a linen cloth. The other third is placed

in a *hausse*—a round wooden or tinned iron receptacle, about 4 inches in height—and fixed upon the top of the moulds, being first covered, as in the previous case, with a linen cloth. A board is now placed over the cheese with a weight above it. At the end of 24 hours the *hausse* is removed, the contents turned, and then placed in a mould similar to the above, and subjected to gradual pressure. This operation is repeated each morning for three to six days, after which the cheeses are taken to the cave, which is of moderate temperature, and salted every three or four days for two months, great care being taken in turning and rubbing them with a cloth during their stay, so that the crust may rest firm and united. In the cave they develop, by the end of three or four months, a bluish mould or spotted character, their weight being, when ripe and ready for sale, about 22 to 27 lbs. They are about 13 inches in diameter, 6 to 8 inches in height, and realise, according to quality, £6 4*s*. to £7 18*s*. the 100 kilogrammes. It is calculated that about 87 quarts of milk make 20 lbs. of cheese.

Gex.

The Gex cheese, named after the chief town of the Department of Ain, at the foot of Mount Jura, is somewhat analogous in its appearance to the Roquefort, except that the blue marbling is more pronounced in the latter than in the former. It is made principally in the Department of Ain, the system adopted being as follows:

When the milk is taken to the dairy it is filtered through a sieve, in which is placed a small packet of dog's-grass seeds, intended to take the place of the cloth which is habitually used. The milk runs into an almost circular receptacle which rests on a stool, and across which, and above the sieve, is fixed a

horizontal iron bar with a handle at one end; to this bar two cords are attached which roll upon it when it revolves. This action is intended to tilt the vat, to which a sort of wooden hopper is fixed alongside, when the whey is being withdrawn. After the milk is filtered and quite cool the rennet is added, and the whole well mixed together, and, in an hour or two, according to the temperature, coagulation will be complete. In summer the cooling process must be hastened by placing in the milk which has passed through the sieve a quantity of cold water in a tinned-iron vessel. When coagulation is complete, the layer of cream which forms on the surface is removed with a wooden spoon and used for making butter, 22 gallons of milk making about 1½ lbs. The curd is next agitated with the spoon and the lumps broken, and, when the mass is in a semi-liquid condition, it is left until the curd has collected at the bottom of the vat. This done, the handle is turned, the vat tilted, and the whey drained off. The curd is then broken into pieces, well worked with the hands, and placed in the moulds. A circular wooden disc, which exactly fits into them, is next placed on the curd (see Fig. 153), together with a weight of 9 to 10 lbs. to facilitate the more complete separation of the whey.

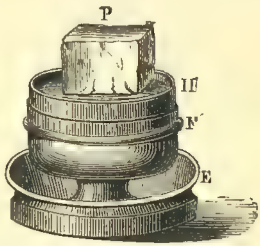


Fig. 153.
Weight (P), Mould (F), Hausse (H), and Basin (E), used for Gex and Septmoncel Cheeses.

If the milk from one milking is insufficient to make a cheese, the curd of two milkings is used and operations conducted as follows:

The curd of the first milking having been placed in the mould and that of the second being ready, the surface of the former is crumbled with the hand. The curd of the second milking is then well worked and added, the whole being covered with a suitable disc and weight. Here the cheese remains for a day, and is once turned during that time, when the salting process is com-

menced. A wooden salting-tub is used in which the cheeses are placed as they come from the moulds, this tub being 14 inches in diameter and 8 inches in height. The top surface is sprinkled with 100 grammes of salt, and then the cheese is left for 24 hours. The tub is then washed with fresh water, the cheeses, of course, being taken out. They are afterwards replaced, the salted surfaces being at the bottom, and those unsalted covered with the same quantity of salt as that mentioned above. This process is repeated daily, but the quantity of salt is gradually diminished until the cheeses are fit to be taken out of the tub. The length of time they remain in it depends upon their size; but it may generally be concluded that they are sufficiently salted when the crust is pretty firm and consistent. If, before finally leaving the moulds, it is observed, by pressing the finger against the cheeses, that any part is less firm than another, that part should be covered with a little salt. When the salting process is finished, the cheeses are taken to an apartment, where they are ripened and take the blue colour common to them. This apartment should have a northern aspect, without any opening whatever to either the south or west. The subterranean caves which are generally used are, on account of the circulation of a fresh and humid air, of great assistance to the proper refining of the Gex. The shelves on which the cheeses are laid are made of two narrow planks joined to two transverse ones in such a way that the air has free circulation between every cheese. The cheeses, which are placed in order of their age, are turned and carefully examined every day. In time, they undergo a special fermentation, the soft part becoming spotted or marbled. Cheeses made in summer are fit to be taken out in 3 or 4 months, while those over-salted are coloured with difficulty.

Septmoncel.

This cheese takes its name from the village of Septmoncel in the Department of Jura, and in its character it has much in common with the Gex, Sassenage, and Roquefort. The district of Saint Claude in this Department is the principal seat of its manufacture, the quantity which was made there in 1871 being nearly 800,000 lbs., of the estimated value of over £21,000. Its system of manufacture is identical with that of the Gex and the Sassenage, 100 litres of milk (about 22 gallons), when converted into fat cheese, making on the average about 16 lbs., in addition to 2 lbs. of butter. The wholesale merchants have a method of their own, which they adopt to distinguish between Septmoncel made entirely from cow's milk and that made partly from goat's milk, and, although they buy both kinds of cheese, the retailers almost invariably prefer that made from the former, for the reason that it does not acquire with age that tallowy flavour common to the other variety. The goat's milk, however, adds a special and agreeable taste to new cheese, much appreciated by consumers. In Paris, Septmoncel cheese is sold indifferently as Gex or Sassenage, but Lyons is the great market for cheeses of the first quality, and Saint Etienne and Roanne for those of the second quality, the latter being chiefly consumed by the working classes. The former realise in Paris from *2s. 9d.* to *3s.* the kilogramme of 2¼ lbs., although, of late years, their consumption has greatly declined.

Sassenage.

This cheese, which is hard and spotted in appearance, and on the average some 12 inches in diameter by 3 inches in height, is made on the Alpine littoral of the Isère from an admixture of the milks of the cow, the ewe, and the goat, nine-tenths of the first-named generally being used in the manufacture, although

the makers state that the greater the quantity of goat's and ewe's milk added the better the quality of the cheese. Its manufacture is similar to that of the Gex and Septmoncel, and, when well made, possesses a very fine and delicate taste. Its retail price in Paris is from *2s. 10d.* to *3s. 2d.* the kilogramme.

FIRM OR HARD CHEESES.

Cantal or Guiole Cheese.

This important cheese is made in the district of the Auvergne and the mountains of Aubrac, and its manufacture constitutes the chief means of utilising the pasturage of those parts of France. It is cylindrical in form and about 13 inches in diameter, the weight varying from 40 lbs. to 120 lbs. In colour it is yellowish, while in flavour it is at once insipid and piquant.

The buildings in which the cheeses are made are small cheese cottages, or *châlets*, known by the local name of *burons*, and comprise a ground floor and one upper storey. On the former are two apartments, one in which the utensils are kept, and which, if necessary, can be heated by a fire, and where, also, the work-people take their meals; the other is a cave in which the cheeses are deposited. The upper storey is used as a sleeping apartment. The cows are milked in the pastures twice a day—at 4 a.m. and 3 p.m.—and the milk, which is received in wooden pails of about 25 quarts capacity, is poured from them into round vats or tubs called *gerles*, holding from 20 to 40 gallons, and then taken to the *burons*. When it has been strained it is sometimes poured into larger vats. The rennet is usually added to the milk in the *gerles*; the milk is never heated, as it is usually of the required temperature, 72° to 74°, about an hour after it is received from the cow. In an hour after setting, the curd is broken up, and if the process is properly performed, separation will take place in fifteen minutes, at the end of which time the cheeseman profits by the

softness and pliability of the curd, and gathers the separated portions of it into one lump while they remain in the *gerles*. The whey is then, as far as possible, carefully taken off, and the curd drained and kneaded. The latter is put into a large, flat, wooden receptacle called a *faisselle*, which is pierced with holes through the bottom and then well pressed. After this, the cheeseman, with bare arms and turned-up trousers, mounts the table upon which the *faisselle* stands, and presses the mass with his hands and knees, the object being to prevent the curd from becoming cool, when it would lose much of its agreeable flavour. The operation takes about an hour and a half to perform, when the curd, or, as it is then termed, the *tome*, is reversed, and a stone placed upon the *faisselle* and left for 12 hours. It is believed that by using the warm members of the body in working, the heat is maintained better. More whey is thus expelled, and the *tomes*, several of which are required for a cheese, are placed in a receptacle, covered with a light board, and lightly weighted. If the temperature is too low, they are placed near the kitchen fire. Here the caseous mass undergoes a remarkable change through the disengagement of carbonic acid gas, which influences the cheese and creates numerous small holes within. In two or three days the curd becomes a clear yellow in appearance and of an unctuous character. The moulds are next filled. These are composed of three parts, the first being a wooden cylindrical recipient, 13 to 15 inches wide, and 6 inches high, the bottom of which is pierced with holes; the second is formed of a circular piece of beech-wood 7 to 8 inches high, and is attached to the former and held in position by the third portion of the mould, consisting of two circular pieces of wood 2½ inches in diameter, and fastened to the top and bottom of the cylindrical vessel. Before being filled, the moulds are placed upon low, triangular, three-legged tables having a rim round the edge, which at one angle is left unjoined to allow all liquid to run off into a small tub placed underneath to receive it. In filling, the lumps of curd are

first finely broken, and then salted, the quantity of salt used varying according to the season of the year and the tastes of purchasers. The cheeses are next placed in the press, and covered with a large linen cloth, the presses employed being, in very many instances, of the most primitive kind. In 24 hours they are turned and again pressed, the final pressure being not less than 40 lbs. to the kilogramme. When this is complete the cheeses are removed from the moulds and taken to the cave, where they are carefully attended to and frequently washed with white linen cloths dipped in fresh water, the water being salted in the summer months to prevent the growth of mites. It is in the cave that the Cantal takes that rich character and flavour so well known to consumers. When ready for sale they are divided into fat cheeses and ripe cheeses, the former being made in the spring, and the latter from May to October.

The whey collected during the various stages of the manufacture of this cheese is put upon one side for eight to fifteen days (sometimes for a longer period), when the cream which rises to the top is converted into an inferior quality of butter known as "mountain butter." It is useful for culinary purposes, and is not unfrequently given to servants, the skimmed whey going to the pigs.

In the year 1873, the quantity of Cantal cheese which was made exceeded 9,500,000 lbs., representing a value of about £190,000. It is consumed chiefly by the poorer classes, who purchase it at the rate of about 11*d.* a kilogramme, and on account of its mediocre quality comparatively very little is exported. The spring cheeses are ready for sale in two months, and those of summer realise about 6*d.* a pound when ripe and of the first quality. This returns the farmer a little over 1*d.* a litre, or about 5*d.* a gallon for his milk.

The Port du Salut and Rangiport.

These cheeses are analogous in their character and manufacture, and have only been known from fifteen to twenty years. The Rangiport, which is the most modern, is the chief of two products which are made from the milk in order to obtain the best pecuniary result, the second being butter, which is manufactured from the whey, 22 gallons of milk of good quality usually making about 27 lbs. of cheese and 2¼ lbs. of butter.

The rennet is added to the milk after the latter has been heated by steam in a semi-globular copper vat to a temperature of 38° Fahrenheit in summer, and 90° Fahrenheit in winter. The quantity used for 22 gallons of milk is about half-an-ounce (16 grammes), but before it is put into the vat, it is mixed with a quantity of water, so that the total volume will in summer nearly equal 6 cubic inches, and in winter 5 cubic inches.

This vat is enveloped by an outer shell of brass, and is placed upon a stand having three legs, which may be raised or lowered at will. It is furnished with two taps and a plug for the purpose of allowing the steam to enter and pass away after heating the contents, and also for allowing the waste contents to be readily removed. When fit, the curd is broken up, and beaten by an instrument resembling an egg-beater, this process imparting a particular grain to the cheese. The temperature of the curd during the operation must not exceed 100° Fahrenheit in summer, or 95° Fahrenheit in winter, and when it has been reduced to pieces of the size of grains of wheat it is left for a few minutes to settle, after which the whey is drawn off through one of the taps above mentioned. It is then put into the moulds; these are made of tin-plate and are about 10¼ inches in diameter, and 3 inches in height. Each mould is placed upon a square piece of beech or poplar-wood, and furnished throughout with a linen cloth. They are next laid upon a table with wheels and drawn up to the vat. A quantity of curd is then placed into each

mould, and this is pressed with the hand until it descends to about an inch below the edge, when the linen cloth is folded over, and the pressing commenced. Each cheese is weighted with a hard, round wooden disc of about half-an-inch in thickness and of a diameter a little less than that of the mould, and upon the top a weight of 12 lbs. is at first placed. The length of time occupied in the process is about six hours, during which period the linen cloth is changed three times in the first hour, twice during the second, and once only during the third. A fresh square board, similar to that above mentioned, is also provided each time the cheese is turned. The pressure should be progressive, a cheese of 6 lbs. being provided with a weight of 12 lbs. only for the first hour, 24 lbs. for the second, and an additional 5 lbs. afterwards. When this is finished, the salting is proceeded with. The weights, discs, and cloths are removed, and the cheeses again placed upon dry square boards, and taken to the drying-room, where they are placed upon shelves, the temperature being not less than 57° Fahrenheit, and a moderate ventilation being also provided. This operation is one of the most important in the manufacture of the cheese, and is characterised by two chief points—the slowness with which it is conducted, and the weakness of the salting substance used. If it is desired to preserve a sufficient softness in spite of the rapid "cooking" which the curd has undergone, it is indispensable that great care should be exercised; but, on the contrary, if too much salt is used, and that too quickly, the cheese becomes hard and loses those special properties so particularly agreeable to large numbers of consumers. Between one and two ounces of salt are used to a cheese weighing one kilogramme (2¼ lbs.). The cheeses are salted daily during the fifteen to twenty days they remain in the drying-room, this operation being performed by means of a large brush dipped in a solution saturated with salt. In order, however, to ensure their perfect preservation it is usual with some makers, especially during the summer, to use salt in its natural state for the

first three days of the salting process, and brine during the remaining twelve days. They are next taken to the cave, being covered with a thin yellowish crust, if the process has been properly conducted. The cave must be made in the ground at some depth, and so constructed that in summer its temperature will not be above 52° to 53° Fahrenheit. It should be vaulted, paved with flagstones, whitewashed, and provided with shelves upon which the cheeses can be placed. The cheeses, during the five to six weeks they remain here, should be the objects of very careful attention, frequently turned, and rubbed on every occasion with a soft cloth wetted in tepid salt water. As a general rule the turning and rubbing take place every two days during the first fortnight, every four days during the second, and every eight days during the remainder of the period.

Minor Varieties of French Cheese.

Among other cheeses, which it is not necessary to describe, partly on account of their incompatibility with farm operations and the public taste of this country, and partly because some of them are local varieties of cheeses which have already been referred to, are :

The *Gournay*, a small, soft, rich, round cheese, of about 3 to 3½ inches in diameter and ¾ of an inch in height, and which is made from milk which has been more or less creamed.

The *Malakoff*, a small, round, flat cheese, generally sold fresh in the shops of Paris, and resembling the Bondons in texture and flavour.

The *Carrés affinés* very similar to the above, but 2 inches square by 1 inch in thickness.

The *Olivet*, made in the Department of Loiret, more particularly in the vicinity of Jargeau and St. Benoit. It is very similar to the Camembert.

The *Rollot*, manufactured in various communes of the *arrondissement* of Montdidier, one of which bears the name from which the cheese is taken.

The *Troyes*, made in the Department of the Aube, is a round cheese 4 inches in diameter by 2 inches thick.

The *Langres*, made in the Department of the Haute Marne.

The *Compiègne*, manufactured in the Department of Oise, is a round, rich cheese, 3½ inches in diameter and ½ inch in thickness.

The *Macquelines* and *Thury*, both of which are made in the Oise, the former being a pale-coloured cheese, 5 inches square and ½ inch thick.

The *Ervy*, manufactured at Ervy, chief town of the canton and about 20 miles from Troyes.

The *Chaource*, principally made at Chaource and the villages around, is a round cheese, 4 inches in diameter by 3 inches in thickness. It is rich but pungent.

The *Barberey*, called after the village of that name near Troyes.

The *Soumaintrain* and the *Epoisses*, made respectively in the Departments of Yonne and Côte d'Or.

The *Maconnais*, a rich goat's-milk cheese, 2 inches square by 1½ inches in thickness.

The *Excelsior*, a strong-smelling, heart-shaped cheese an inch thick.

The *Tuile de Flandres*, a rich, ripened cheese, 2 inches thick by 4 inches square.

The *Bourgogne*, a strong, round cheese, 4 inches in diameter by 3 inches thick, made of both new and skimmed milk.

The *Trouville*, a very rich cheese, usually ripened and covered in tinfoil. It is 4 inches square.

The *Poitiers*, a small goat's-milk, loaf-shaped cheese, 2 inches in height.

The *Providence de l'Abbaye Bricquebec*, a very rich, hard, round cheese, 8 inches in diameter by 1½ inches in thickness, usually covered in cheese-cloth, and resembling the Port du Salut and Rangiport.

CHAPTER XX.

THE DAIRY IN FRANCE.

BUTTER-MAKING.

FIRST-RATE butter is made in France, as British consumers very well know, and we have watched with some interest the sale in the Paris market, where, as each package is handed up, it is tasted by one buyer after another as it slides down a long bench, and sold by the time it reaches the bottom. These packages are mostly of wickerwork, and into them the lumps of butter, covered with a clean cloth, are placed, fastened down and sent to the Parisian market. It is almost unnecessary to say that while the French buyer generally retains the finest samples, he sends to us his second quality, and for this we pay a very good price, and consider it superior, especially if it is well displayed by the retailer, and labelled Brittany or Normandy. In these districts, it is true, good butter is made, and if the producer does not obtain so large a quantity from his animals, he almost makes up in price, for he generally receives a larger sum per pound than his British neighbour.

Like the system of collecting eggs from small producers, the butter dealer buys up small dairies weekly, and mixing the butter according to quality, sends it away in the packages described above. In many French markets the farmers will be seen with their butter offered for sale in huge lumps, instead of pounds and half-pounds as in England; and if it does not by this

means yield so great a return—which, however, we doubt—yet it saves a large amount of trouble. The dairy utensils in general use are quite as primitive as those in Switzerland, and seldom is any other churn used than the simplest of barrels, or the old-fashioned tub or "dolly-churn." In the former are no complex beaters or dashers; on the contrary, they are perfectly plain, and fixed across the centre of the ribs, while the latter is sometimes worked in a very simple manner; the top of the dolly-stick is fixed to a rod, one end of which is loosely attached to a beam across the room, and weighted, while to the other end a rope is fastened which the operator pulls. The cream pots are mostly of earthenware, and like those used in many British dairies, but we saw few skimmers, wooden scoops being used as in Switzerland, or perforated spoons of large size. Instead of shallow milk-pans, the Frenchman uses a deep earthenware vessel, which is described farther on. The whole routine of French dairying is as simple as the utensils—no separators, butter-workers, Cooley creamers or aërators are found, at all events not in the districts which we have visited. There, milking takes place twice daily, while in some parts, where the dairies are not so large, the rule is to milk three times, the cows being out all day, and tended the whole time by the farmer's wife, daughter, or children, much of the pasture being contiguous to crops, which are not protected by hedge or ditch. The milk is strained through a cloth which is largely used in the district, but it is seldom cooled or aërated.

With regard to skimming, no special practice is general: some farmers skim daily, others only every other day, while others again skim twice. In the same way churning varies not only according to the size of the dairy, but to the ideas of the farmer. The very best makers skim early and churn often, and they are rewarded by the very best of butter; at the same time it is to be doubted whether, considering the extra labour and some loss of cream, they are better remunerated than those who skim twice, and churn once or twice a week. It will of course be observed that

in hot weather the systems referred to are somewhat altered, skimming being everywhere very frequent. In churning, the Frenchman is more particular than the English butter-maker; he does not wait for the butter to solidify, but ceases churning immediately it granulates. To detect the sound which tells him it has come, he is always on the *qui vive*, and he draws a peg which is fixed in the centre of the churn when he thinks he hears a change, and this at once sets him at rest. If butter granules adhere to it he ceases churning, if not he continues as before at his usual jog-trot pace. When the butter has come, the butter-milk is run through the straining-cloth into a vessel below, and the churn is filled with water to the same extent that it was with cream, but never more than half full. It is then turned half-a-dozen times very gently and again emptied, and so on for three or four times, until no buttermilk is left in the churn. The butter is now not only thoroughly clean but solid, and is removed from the churn with a wooden scoop, never adhering to the sides of the churn at all; the water is then gently worked out, it is at once made into one shapely lump, and the thing is done.

Having visited the Departments of Calvados and Manche, and taken considerable pains to see and understand the systems adopted by those engaged in the dairy business, we are enabled to present a more complete description than has, we believe, ever appeared in English. The following remarks apply chiefly to the district of Bayeux and St. Lo, and while we describe only what we have seen, yet we are bound to state that we are indebted to M. Morière for many of the particulars and figures.

The district of Bayeux was the first in which butter-making was carried out in the best style, and in which the very best class of butter was made; but the fame which it soon acquired caused the industry to be taken up farther and farther afield, until it assumed the importance which has now so long been recognised. Much, however, is credited to the railway, the extensive steam-packet service with England, the treaties which have been con-

cluded with other nations, and lastly, the success of Isigny butter at the French Exhibitions. These causes have brought to a climax an industry which means some 70,000,000 fr. per annum. Butter-making is the one great idea of the people, and, indeed, they consider it their glory, as a recent French writer admits. He says that no district in the world surpasses it in relation to the quantity and quality of its product, especially that sent to the markets of Paris, London, and Brazil. Isigny butter is really a name given to the samples of first quality; but it was originally applied only to the best of that sold in the chief market hall in the canton—the produce of the fertile districts of Bayeux, Trèvières, Isigny, Ryes, Balleroy, and Caumont. So important is butter at the present time, that upon many farms a sufficient crop of corn for the use of the *personnel* is never grown. Everything is sacrificed to the one supreme object; and, when visiting a farm, one may rest assured that, of all apartments, the dairy will be shown with as much pride as is displayed by the opulent in exhibiting their collections of art and vertu. Nothing so much strikes a stranger when visiting this district as the immense tracts of rich grass land, all carefully inclosed, with splendidly made hedges and ornamented with trees, intended to shelter the cows from the rays of the summer sun and the rigour of winter.

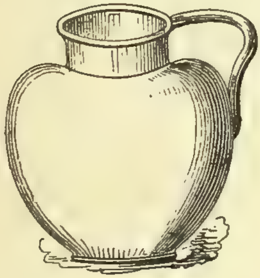


Fig. 154.
Norman Milk *Canne.*

In this district milking is an operation which is performed twice a day, but mostly thrice, by maids, who, having well washed their hands, proceed to the fields with their *cannes* (Fig. 154); and the milk, absolutely drained from the udders, which are kept healthy and clean, into these well-known brass vessels, tinned in the interior, is carried home in cages fixed on the back of an ass, or, as is more often the case, a pony, kept exclusively for the purpose and

called a *trayon.* There are two well-known methods of preparing for the churn. The ordinary system is that in which the milk is set for a time that the cream may rise, when it is skimmed and churned. It is believed that if the most delicate flavour is not obtained in this way, yet the quantity extracted is more abundant. It has been ascertained by experiments on a large scale, that 22 litres of milk (a litre is about 1¾ pints) give at the end of 24 hours about 2¾ litres of cream and 1 kilogramme (nearly 2¼ lbs.) of butter. By the other method the milk is churned as soon as it is drawn from the cow, but from the same quantity of milk only 610 grammes (21½ ozs.) of butter are obtained, which, however, is of the choicest possible flavour, although it is preserved with more difficulty than that made from cream. In Calvados the first system is chiefly adopted, and the farmers manage to obtain from new cream, particularly in the Isigny district, a butter of fine flavour, which preserves well, and goes farther in the kitchen than any other. When it reaches the farm the milk is immediately poured into the earthen vases called *serènes*, being at the same time strained through a cloth, which is frequently washed. This operation is termed the *coulage.* The *serène* (Fig. 155) is a conical-shaped pan, made of a brown freestone found in Noron (Calvados) and Vindefontaine (Manche); it is durable and close in texture, and a natural glaze or varnish forms upon its surface when filled with milk, which opposes the filtration of liquid. In these vessels occurs the important operation of the ascension of the cream; consequently much attention is paid to their cleanliness. They are daily rubbed with nettles, generally in the presence of the master or mistress, and afterwards boiled in a copper for half-an-hour, an operation which is termed *nettoyage;* next, to destroy all trace of impurity, they are dried over a moderate coal fire. This is termed *grillage.*

Fig. 155. *Serène*, or Milk pot, used in the Bessin.

In this district the dairy, like the granary in Beauce, attracts all the attention of the farmer. It is always placed upon the ground floor, and in the most convenient situation possible, not only for the sake of economy, but because of the large quantity of water used in cleaning and cooling. In view of the temperature, it is always in a cool place, facing the north, sufficiently airy, and generally with trees growing in a position to shelter it from the southern winds, which are regarded with much suspicion. Ventilation is also facilitated by arrangements of pipes, which economise currents of air and carry them out of the building. In the district of Bray the dairy is generally underground, and although a uniform temperature is more easily maintained throughout the year, yet it cannot be kept in the same state of neatness and perfection. The milk, the cream, and consequently the butter, sometimes therefore acquire disagreeable flavours, which are unknown in the produce of the dairies of Isigny. Here care is taken that chimneys, stables, piggeries, and cowsheds, are at a distance; and so particular are the farmers and their wives to prevent the least unpleasant odour from reaching the dairy, that they sometimes push propriety too far, and send for the dairymaids who had neglected to change their sabots before entering its sacred precincts. A thermometer is always used in the best dairies that it may be more easily seen if they are at the right temperature—between 10° and 12° Centigrade (50° to 53° Fahrenheit). This they maintain by warming in winter and cooling in summer. The stove for heating is placed in an apartment contiguous, pipes entering the dairy. On some large premises they have established hot-water systems, which have the advantage of maintaining a more even temperature, without the danger of admitting smoke or any unpleasant odour. In lowering the temperature, it is the custom to pour a large quantity of very cold water over the flagstone floor, in which is a small trench to carry it away. These flagstones are of Fontenay, a hard, calcareous stone, almost as fine as blue limestone, and are often built with shelves or stages, on which the *serènes* or milk-

pans stand, sometimes in the centre, but more generally next the walls. In some cases, too, these stones form a border, between which and the wall is a certain quantity of water, in which the *serènes* are placed. They are, however, usually set where they will not be touched and shaken and the cream disturbed.

The method of "cooling" (*refroidissement*) is described by the eminent authority we have mentioned before, as affording advantages which cannot be obtained by temperature in its common acceptation. He says: 1. The rising of the cream is much more expeditious when the temperature to which the milk is brought and maintained more nearly approaches zero. 2. The volume of cream is greater, and produces a larger quantity of butter. 3. The skim-milk, the butter, and the cheese are of better quality. "This being so," says M. Morière, "we ought to fear the butter of Sweden and Denmark, and we should hasten to modify our system, and reduce our temperature of 10° to 12° Centigrade." These advantages have not, however, been found in all cases in which the system has been tried in France. The method of cooling milk is admitted by the French to produce butter of first-rate quality, which can be preserved for a long time, and consequently that made in Sweden, and particularly in Denmark, has become celebrated and the trade extended; but, so far, it has not shown its superiority to that of Isigny. Again, the French consider that it is not possible to institute a comparison, because the butters of Sweden and Denmark are salted before leaving the farm, while that of France arrives at the market in a fresh and unsalted state. The French farmer makes butter which he knows will be judged by skilled merchants for its aroma, its taste, and its consistence. The northern farmer, on the contrary, prepares a butter specially for exportation, and in which the qualities which have given their value to the French article are completely hidden and replaced by its ability to resist rancidity. His system is always the same, for in his country the consumption of unsalted butter is almost unknown.

If, however, his system of cooling has great advantages, it seems to us that he loses them by keeping the cream for too long a period, inducing an acid reaction, and consequently lessening its sweetness. The French also think that the northern makers subject the butter to too much kneading and working, which cause it to lose its consistence, while the acidity they encourage in the cream deprives it of its aroma. We are of the same opinion upon the latter point, for the sweetest butter we ever ate has been in districts where the cream was churned while sweet. An experiment was made at the School of Agriculture at Grignon to show the value of the cooling and the Norman systems, as follows: Cooled milk, 30 litres, skimmed at the end of 14 hours; cream, 4800 grammes; butter, 1030 grammes. The milk, here about 26 quarts, gave a little over a kilogramme, or actually about 2¼ lbs. of butter. Milk, not cooled, 30 litres; cream, obtained by two skimmings, 3860 grammes; butter, 903 grammes, or a little more than ¼ lb. less than from the cooled milk. M. Pouriau, who conducted this experiment, remarked that—the skimmed milks having been left to themselves in the dairy until the evening—the cooled milk showed a very thin skin at the top, while the other was very much thicker with cream. If these creams had been united to those taken in the experiment, he believed that the butter from the uncooled milk would have approached that obtained from the cooled milk. This experiment was made chiefly to learn whether the cooling method deprived the butter of aroma and flavour, and the result was, as ascertained by the opinions of more than twenty persons who were present and tasted it, that the sample from cooled milk was very fine as paste—which, we suppose, means that its grain and consistence were good—but without aroma or flavour. The other was considered "very fine, very palatable, very aromatic; excellent." The difference between the two was so great that it was sufficient to smell them without having recourse to the taste. If, then, the cooling system offers advantages where butter is

prepared with salt for immediate exportation, it is evident the French think that it is not favourable to the production of choice butter destined to be consumed at once without salt. In many well-kept dairies the operation of skimming is not performed under 24 hours in summer, and 48 hours in winter, although there is really not a fixed rule; the skimming is according to the formation of the cream. The cream, taken with an iron utensil called an *écrémoir*, pierced with holes through which the milk can strain, is placed in other vessels of stone, and becomes the object of even more minute care than the milk itself. These cream vases are placed in a distinct apartment adjoining the dairy, and there they are left until the farmer is about to make the butter. It is a fact well known to all intelligent butter-makers that the fresher the cream—that is, the quicker it is skimmed and ripened—the more delicate is the butter, and the higher the price it obtains in the market. This should be printed in letters of gold, especially in England, where so many persons are infatuated with another system, in which stale soured cream plays an important part.

The time necessary to obtain the butter by churning varies according to the season, the form of the churn, and the temperature at which it is churned. In summer, the barrel-churn we have referred to often brings it in 10 to 15 minutes; but in winter an hour may be required to obtain the same result. Churning must neither be too quick nor too slow. If too quick, the butter loses its aroma, and acquires a disagreeable flavour; if it is too slow, it forms with difficulty, and is not of the desired quality. It is very well known that the temperature of the cream has a marked influence upon the rapidity with which the butter is formed. It comes in the least time when the cream is at a temperature of 14° Centigrade (57° Fahrenheit); but care should be taken to use the thermometer, which is indeed one of the most useful instruments in the dairy. Its use, in observing the temperature, will always indicate whether the latter is to blame, when, on account of lengthy churning, the quality of the milk is

doubted. In winter the churn is warmed before the cream is poured into it, either by placing it near the hearth or by pouring some warm water into it, and allowing it to remain from 15 to 30 minutes. At this season, too, churning takes place in the middle of the day. In summer the coolest period of the day is selected, whether morning or evening, and the churn is generally half-filled with cold water and allowed to stand some time before using. Also while churning, the churn is covered with a wet linen cloth, which is occasionally plunged into a bucket of cold water. The butter does not form in a complete lump, but in fragments more or less considerable, and these are gathered together into one mass upon a table on which it is at once kneaded.

The operation of washing the butter—which is chiefly conducted in the churn, and by which means the remaining buttermilk and the caseine retained in the interstices of the butter are separated—is of great importance if it is to be prevented from losing quality or turning rancid. After this *délaitage*, or washing, the kneading is completed, either with or without water, sometimes with the hands, and at other times with a wooden worker. "The washing is so important," says M. Morière, "that the butter often makes as much as 50 to 60 centimes per kilogramme difference in the market." The higher the temperature at which the butter has been produced, the more obstinately it retains the caseine, and the more difficult it is for the cold water to carry it away; it is therefore sometimes washed with water containing a small quantity of alkaline matter, such as bicarbonate of soda, which readily dissolves the foreign particles within it. Once well set in lump, the butter is carefully covered with a very clean linen cloth, and then placed, well enveloped in sweet straw, in a basket, and in this condition it is sent to market. That which is preserved for the household is salted at the rate of 500 grammes to the 10 kilos. of butter—that is, 17½ ozs. to 22 lbs. It is well to expose the salt to the air for some time, in order to free the deliquescent

salts that it may contain ; this being done, it is dried in an oven and then finely pulverised. In adding the salt the butter is well kneaded, and it is then put immediately into clean brown stone pans, the surface being covered with a layer of salt when they are sent away, but when it is simply stored at home it is covered with strong brine, which is kept on until the butter is sold or used, otherwise it quickly becomes rancid.

Although there are a number of splendid markets in Calvados and Manche, the larger portion of the finest butter is sent direct to Paris by the producers, without passing through the "halles du pays." At Isigny, butter is a special article of commerce, and the merchants attend its market in numbers, and salt their purchases in barrels and large cylindrical pots called *mahons*, large quantities of which are sent to us in England and to America from the little ports of Carentan and Isigny, and from the larger ports of Honfleur and Cherbourg.

The system adopted by the butter merchants who buy of the farmers the lumps of butter which may be seen at Isigny and other markets is as follows : Each lump is cut into pieces in order to ascertain its general quality, whether it is absolutely firm, and how much salt it will take. The pieces are then placed in a large wooden circular-bottomed trough, called a *jatte.* A quantity of cold water is next poured over the whole, and it is worked by the hands of three or four men, who take each piece one after the other, the last workman piling them at one end where the butter is washed. The water is then run off and the butter allowed to drain, when it is again worked and passed from one man to the other, until the whole is piled at the other end. The chief workman afterwards weighs a quantity of finely pulverised salt to the extent of from five to ten per cent. of the weight of the butter, according to the market for which it is destined. He next sprinkles it over the mass through a small wire sieve, which is generally used for the purpose. Each piece is then cut open and the salting completed. The workmen next take each lump of

butter and thoroughly work it with the hand a second time to entirely incorporate the salt, every lump passing through the hands of each man. The lumps are then cut again and passed through a final operation of working, which is conducted as before. The butter is now very soft, and is easily packed in the casks used for the purpose. Great care is taken to pack it thoroughly that no spaces may be left. The casks are made of ash, and are bound together with hazel hoops. Their usual size is 14 inches in height by 11¾ inches in diameter, and, when full, they weigh 45 lbs. It is customary to place a layer of salt at both top and bottom.

Almost all the cows in the butter-making district of Isigny are of the Cotentin breed, and are of first-rate quality, but they are not bred with sufficient care, nor is proper attention given to the bulls. In the Bayeux district the heifers are sent to the bull at two years old, and in all large dairies they invariably test the yield of newly-calved cows to see that it is what it should be, and that it makes a proper quantity of butter. The animals are left in the fields as much as possible, unless the weather is very severe; but even in mid-winter they carry them dry food rather than bring them into the stables, believing that butter made from stalled cows is much inferior to that from those which are at liberty in the pastures. They estimate in Calvados that it requires 25 to 28 litres of milk for one kilogramme of butter, which comes to about the same thing as the English estimate of 11 to 12 quarts per pound, and that the annual production of a cow is 125 to 150 kilogrammes of butter. In estimating each kilogramme at 3 fr., although a large portion of the butter is sold at 4 fr. to 5 fr., it is found that a cow returns for this product alone above 400 fr. per annum. This sum is often considered as net profit, for the butter-milk and skim-milk which is used in raising calves and pigs, together with their manure, is estimated as an equivalent to their cost of feeding and attendance.

With regard to food, the mangold, and especially the distillery waste, is much used, and aids materially in the production of milk, although it is less rich in fat. The same may be said of the potato; but the carrot and the parsnip—the latter being too little cultivated—both furnish milk rich in butter. Sainfoin is considered of great value, and is much grown, but grass is preferred to everything, and the most intelligent farmers reserve as much as they can for the winter, that their butter may lose none of its quality.

From Isigny we drove to the farm of M. Duprè, a farmer who sends a large quantity of butter direct to Paris, as do many others; indeed, the dispatch of butter which has not been marketed at all, is, as we shall show, very large indeed. In this district the rent of land is often as high as 250 fr. the hectare, and is highly cultivated. The retail price of the best butter was 35 sous, whereas in remote districts of England scarcely 23 can be obtained.

M. Duprè's system includes butter-making, calf-breeding and fatting, and pig-keeping. The rent of his farm is 20,000 fr. a year; but M. Duprè makes money, and he deserves it, for he is indeed a horny-handed son of toil. With nothing in his appearance to denote the well-to-do farmer, he is an astute and sensible man. In the blouse and sabot he is at home, and is among his stock from sunrise to sunset. In the churn-room we were impressed with the great cleanliness observed. The huge barrel-churn is worked from outside, and the axle is fitted with a patent arrangement, which locks and instantly stops the movement. It is used twice a week, and holds 600 litres, and even then it is not large enough for the dairy. M. Duprè makes 100 kilos. of butter per churning, or, in all, some 440 lbs. per week. This is sent to the merchant direct, and obtains the top price. The skim and buttermilk go to the pigs and calves, the former getting cut cabbage in addition, and the latter absolutely nothing else. The buttermilk, instead of being carried, is drained directly away, and

runs across the farmyard into a reservoir near the piggeries. The calves (uncut) are all stalled in lengthy and roomy houses, and they are sent to Paris for veal. The cows, a large number, were all at grass, and were chiefly of the Norman breed, some giving at their best 28 litres a day, the best score averaging from 20 to 24 litres during the finest weather. In summer they get nothing but grass, but in winter mangolds and carrots are largely used, in addition to hay; and M. Duprè spoke very highly of carrots. His buildings, like most of those on these farms, are not much to look at, but are strong, warm, and exceedingly convenient within. The milk room, containing 60 *peaus*, was identical with those described above, and plenty of water was used, the brass cans and butter stools forming almost the entire furniture. Asked if he liked the *Cooley* system, M. Duprè admitted that there was something good in it, but said that he should never depart from his own, which costs a great deal less. Butter-workers he has no faith in, and machinery of all kinds appeared to be his abomination.

Preserving Butter.—There are several systems of preserving butter adopted in France, among the chief of which are those known as the *Appert* and *Bréon* processes. M. Appert selects fresh butter of the first quality which has been thoroughly deprived of its buttermilk, and afterwards pressed in a linen cloth in order to extract as much moisture from it as possible. He then introduces it by small pieces into short-necked glass vessels, pressing it down thoroughly into the interstices. These bottles are then hermetically sealed with prepared stoppers and fastened down with wire. They are next placed in a large vessel of cold water and heated up to the boiling point, when they are taken out and put away to cool. In this manner the butter is preserved, and its good qualities retained for at least six months.

M. Bréon obtains a similar result by the use of tin boxes into which the butter is firmly pressed, and covered with a small quantity of liquid composed of 6 grammes of tartaric acid and bicarbonate of soda, which have been dissolved in a litre of water.

The boxes having been filled, they are covered and soldered down.

A few figures showing the marvellous extent of the butter industry in Calvados will be found interesting. They were collected by the Professor of Agriculture of the district, from the market, railway, and Government accounts, and are most reliable. The accounts include a series of ten years, and taking one of these (1876), which was a medium year, we find that the following is the result:

	Kilos.		Francs.	
Butter sold in the market... ...	6,671,000	...	24,250,000	
,, forwarded by the railways	4,196,000	...	16,750,000	
,, exported	9,262,000	...	27,750,000	
,, consumed in Calvados ...	3,000,000	...	8,500,000	
	23,129,000	...	77,250,000	or £3,090,000.

Taking the markets for that year, we find that they may be divided into six districts, each of which has from four to seven markets. These districts are: Bayeux, Caen, Falaise, Lisieux, Pont l'Evêque, and Vire; Bayeux being by far the most important, and Lisieux next. In Bayeux are Isigny and Caumont, the two largest markets, excepting Livarot, in the Lisieux district, which comes next to Isigny. In the last-named market, the butter sold was 1,000,000 kilos., at an average price of 3 fr. 95 cents., the highest rate, and the highest price by far. The price has crept up from 3 fr., in 1867, making an advance every year; but in 1870 and 1871, the two years of the war, the production was just double, although in many other markets it was much less. For ten years the mean price of Isigny butter was 3·40 fr., being only approached by Lisieux, with 3·90 fr., while almost all other markets were below 3 fr. It was ascertained by the Viscount de Neuville, who is a distinguished authority upon agricultural matters in Calvados, that about four Livarot cheeses were made to one kilogramme of butter, or, more correctly, a basket of three dozen cheeses to ten kilo-

grammes of butter. The cheese industry thus makes up in Livarot for its decline in butter. Some of the other markets show a retrogressive movement, or, what is nearly as bad, a stationary position; but the cause is attributed to the growing trade in Livarot and Camembert cheeses, for the number of cows kept is very much larger than ever, and they are still increasing. The following markets, however, have all largely increased in their butter sales: Trévière, Falaise, Harcourt, Lisieux, St. Pierre, Aunay, Vire, and Caumont, proportionate increases in the prices being common to each. During the ten years the markets in the six chief *arrondissements* received and sold 64,250,000 kilos., above 12,000,000 lbs. per annum, or equivalent to 18,500,000 fr. per annum. This, however, by no means indicates the importance of the butter trade, for, as we have stated above, much of it is accounted for in other ways. An account of the Isigny market is published, showing the sales and average prices per month for ten years, and in this is an example of the fluctuation of the price of butter. In every case but one the months of June and July showed the lowest prices, sometimes May and sometimes August being equal; but in 1870–71, November to February gave the lowest price on record—1*s.* 7*d.* the kilo., or about 9*d.* a pound. This price was not doubled until December, 1875, since which winter prices have repeatedly been as high as 4 fr.

According to M. Bromeis, the composition of Isigny butter of the first quality and of badly-made French butters is as follows:

	Isigny Butter, First quality.	Badly-made French Butters.
Water	14·0	18·0 to 20·0
Butter	84·0	78·0 ,, 75·0
Casein	0·5	2·5 ,, 3·4
Lactine and Salts	1·5	1·5 ,, 1·6
	100·0	100·0 100·0

With regard to butter despatched by rail, the Western Railway Company give particulars for one year, showing that 4,250,000

kilos. were sent from fourteen stations, the chief of which were Bayeux, Le Molay, Bretteville, Isigny, Vire, Andrieu, and Lison, in the order named. At the present time the quantity sent is believed to exceed 5,000,000 kilos., or, in other words, it has quadrupled in sixteen years.

If we refer to the exportation of butter, we find that in the ten years—including a port in Manche (Carentan), which is believed to ship one-half Calvados and one-half Manche butter—no less than 76,000,000 kilos. were exported by Calvados, Honfleur taking the lion's share, having doubled its returns in ten years. These butters go chiefly to Brazil or come to England. In 1876, according to the Customs returns, 33,750,000 kilos. of salt butter were exported from France, so that Calvados—one Department only—accounts for more than a fourth of the entire production. In 1876, 29,250,000 kilos. of salt butter came to England alone, and these facts cause the French to take credit that, notwithstanding the efforts of Denmark and other northern countries, their own trade is not diminished. Much trouble has been taken by French Ministers to show that, wherever Normandy and Danish butter compete, the former takes the highest price; but during the past year Denmark has made rapid strides, and has become a real antagonist, while her system, so much depreciated by the French, has also improved in a marked manner.

Lastly, as the inhabitants in the Department number 450,000—25,000 less than in the previous census—it is estimated that 300,000 consume 10 kilos. per head per annum, or 3,000,000 kilos. in all, equivalent to 8,500,000 fr. Thus butter-making in Calvados has been gradually built up, and although in 1867 the industry produced but 30,000,000, it now reaches 77,000,000. The reasons for this are stated to be: 1st, the adoption on the farms of the excellent method of dairying conducted formerly in but one small district; 2nd, the conversion into grass of much land which was formerly devoted to cereals; 3rd, the facilities offered by the railways; and 4th, the reputation which has been acquired by

Normandy butter, especially since 1867, when it obtained the Gold Medal. We often consider the French our inferiors in agricultural matters, but they have built up a position upon butter and cheese which has made two or three Departments absolutely wealthy, and they still pursue the system in a most business-like and thrifty manner. We wish we could point to a single English county in which one-half is done with butter that is done in Calvados; but while we are content to grow corn at a loss, and buy dairy foods at considerably higher prices than we are charged for them at home, we shall continue to contribute to the wealth of Normandy, and the difficulties which beset the land question in England.

CHAPTER XXI.

ITALY AND SWITZERLAND.

ITALY.

THAT the fertile plains of Northern Italy are peculiarly suited to the production of an abundance of first-rate butter and cheese we have always believed, but that belief has been strengthened by a visit which we made to Lombardy for the purpose of witnessing the manufacture of the famed Gorgonzola cheese. The pastures even in late autumn were, as compared with ours at home, and even with some of the best we saw at hand (in Cantons Zug and Schwytz), as summer is to winter, while the cattle reminded us strongly of the Schwytzer breed, to which we believe they owe a great deal. In many respects we found the system similar to that in Switzerland, especially as regards cropping, manuring, housing, and feeding, and it may be considered remarkable by our countrymen—who look with something akin to contempt upon the capacity of Continental cattle—that while the milk yields as much cheese upon the average as it does in our own county of Cheshire, the ordinary cow of the country gives about 12 quarts a day, and it is common to find them yielding 20 and even 25 quarts, very many instances being named in which 30 has been exceeded. These figures, however, high as they are, are exceeded by those mentioned further on. The Italian Government has done something to foster a spirit of improvement in dairy matters, while the Lombardian farmer himself makes his cow the chief study of his life. His land is cultivated as skilfully and laboriously as that in Holland, and while his choicest products are

appreciated by every civilised race, his own countrymen prefer them to the manufactures of any other nation. The best-known cheeses of Italy, and the majority are made in the north, are—

Gorgonzola (Stracchino).	Caciocavallo (Calabrian, Puglian, and Sicilian).
Parmesan (Formaggio di grana).	Chiavari.
Gruyera (Gruyère).	Pecora.
Pecorino.	Mazzolino.
Ricotta (fresh, salted, & smoked).	Fontina.
Rubiole (sheep's-milk cheese).	Fieno.
Proratura.	Formaggini.
Bellunese.	Provote.
Mozzarelle (sheep's milk).	

We are indebted to Dunham J. Crain, Esq., the American Consul at Milan, for many of the following valuable particulars.

Gruyera and *Fontina* are made from the Estival pasturage of the valley d'Aosta. *Rubiole* are small sheep's-milk cheeses of Alba, Mondovi, and Acqui, whence they are considerably exported. *Grana* and *Stracchino* are Novarese products. The former is made during ten months of the year; the latter in October and November. The mode of preparing them is being improved; but the increased price of butter induces its extensive manufacture to their detriment.

A large quantity of excellent butter and *Grana* and *Stracchino* cheese is made in Southern Lombardy and Mortara. Lecco, Varese, Bergamo, and Breschia produce good *Stracchino* and butter. Delicious cheeses called "*Formaggini*" are made on the rich pasture of the Valtellina hills.

Inferior butter and cheese are made in Mantua. Lodi, Pavia, and Milan, which produce 24,000,000 lbs. of butter and 60,280,000 lbs. of cheese, are the best dairying districts of Lombardy. The cheese of Venetian factories is poor, but the butter of the moun tains of Caprio, Basano, and Valdagno is justly famous.

In Asiago there are 85 creameries and cheese factories,

employing 300 hands, and annually producing 33,400 lbs. of cheese, and 37,400 lbs. of butter.

The dairying interest in Liguria is small. The Emelian plain, between the Panaro on the east, and the Tribbia on the west, is, with Lower Lombardy, the centre of Italian cheese and butter-making.

There are 35 factories with 50 cows apiece in the Piacenza district, annually producing 286,000 lbs. of *Grana* cheese and 124,000 lbs. of butter. Owners of 2 or 3 cows send their milk to these factories for working.

Dairying is the chief rural industry of the Parmesians. Their *Grana* (called "*Parmigiano*") is sent to the United States of America. The 129 "*casselli*," or establishments where it is made, are scattered on the plain and on the hills, and have 184 cauldrons for the boiling of milk, and 130 churns for butter-making. In their production of 1,650,000 lbs. of butter and cheese, they consume 9,000,000 quarts of milk. The working season is from April to November, though twenty "*casselli*" are open all the year. The Emelian cheese keeps well, is improved by age, and much used as a relish with meats. It is made as in Lombardy, but because the cream is only removed from one milking, the percentage of poor cheese is less. In Umbria and the Marshes they make a considerable quantity of cheese of sheep's and goat's milk, and a little of cow's milk. That made on the mountains of Visso, in the Camerino district, is excellent and celebrated.

The small Marcerata region produced alone, according to the last report, 160,000 lbs. of cheese per year. It has but few cows, and those of Tuscan and Swiss stock. They give, on an average, from 11 to 13 quarts per day. In some factories, cheese is made of sheep's, goat's, and cow's milk, mixed. Cheese of the first kind is extensively exported, and sells, where produced, at 9*d.* and 1*s.* per pound. It obtained prizes at Florence, London, and Paris. Its excellence is due to the healthy and aromatic

plants which abound on the Marcerata hills. From sheep's milk, the Spoletese produce annually about 770,000 lbs. of cheese. One of their factories makes yearly, from the milk of 70 choice Swiss cows, 23,000 lbs. of cheese, and 2,000 lbs. of butter. The sheep's-milk cheese, called "*Crete*," of Siena, Tuscany, is well known and good. It bears a distinctive name, but is not made by special process. It is prepared by peasants, without system, and in small lots. Factories for its scientific manufacture have been recently erected. Little cheese is made in Lazio, owing to the scarcity of sheep and poor quality of the milch cows.

The sweet cheeses of the Southern Adriatic provinces of Italy, called "*Mazzoline*," are said to be delicious, and equal to any produced elsewhere.

A Government committee reported some years ago that their excellence was due to rich milk; that old modes of cheese-making were followed, that dairying, including utensils, milking, quality and quantity of rennet for coagulating, cheese-making, salting, and preserving, was entrusted to empirics; and that to judge *à priori*, it was sufficient to glance at the wretched dairies surrounded with dirt and permeated with odours. Molise produces 27,000 lbs. of cheese per year, and Terra d'Oltranto 35,000 lbs., or one-third more than in 1870.

Among the Southern Mediterranean provinces, Catanzaro is famous for its butter, Caserta for a peculiar cheese called "*Mozzarelle*," and Potenza for excellent sheep's-milk cheese. The Casertese make 22,000 lbs. yearly, and 26,000 lbs. are made in Benevento. The cows of the Modica district of Sicily are large milkers, and the pasturage is so rich that their milk contains fine butter and cheese-making properties. The cheese produced is equal to that of Parma, Lodi, England, or Holland. Cows stabled give from 20 to 22, and many from 30 to 38 quarts daily. They do not give milk in winter, or at other times when the food is scarce. Sicilian sheep give 1 and goats 2 quarts per day.

In Sardinia, two kinds of cheese are made, viz., that of cow's and that of sheep's milk. Of the latter kind about one-third, or 300,000 lbs., is exported. The Sardinians also produce a large quantity of butter.

Modes of making.—In making Piedmontese cheese, the milk is used when tepid, it is mixed and shaken in whey, which curdles it in a quarter of an hour. The curd is shaken for drainage, and when dry, pressed in a form. Sometimes this cheese is made of partly skimmed milk.

Gorgonzola (or *Stracchino*) is made of milk containing all the fat. When the mountain pasturage is exhausted, the Bergamese herdsmen drive, for wintering, their herds to the plains. Gorgonzola is their favourite halting-spot, for there they first find the luxuriant vegetation of the Lombardian plateau. These herds, revelling on the rich grasses of Gorgonzola, from the middle of September to the end of October, give abundance of milk.

Cheese is made during these months in small rooms devoted to it, in the homes of the Gorgonzolese, who buy the milk of the herdsmen. The autumn temperature, being moderate, is best for cheese-making, as too much heat, by hastening the separation of the whey, makes it too dry and friable, while excessive cold produces a wheyey, acid, and easily spoiled cheese.

The milk while warm from the cow is curdled with well-preserved and prepared calf-rennet. The quality of the cheese depends much upon that of the rennet; and experience guides as to the quantity required. In 15 or 20 minutes, when the milk is coagulated and the whey separated, the curd is hung in hemp-cloth bags to drain. As cows are milked twice daily, the foregoing plan is repeated morning and evening.

The morning-drained curd, enclosed in light, flexible wooden bands, covered on their inside surface with hemp-cloth, is placed on an inclined board strewn with rye-chaff. Being of two milkings, the curd is partly warm, partly cold, and, though

mixed, care is taken to form the upper and lower strata of the warm, because it is more binding. As hot and cold curd never perfectly unite, minute interstices remain in the cheese, in which, while maturing, green mould, known as "parsley," forms and gives the *Stracchino* the delicious taste for which it is famous.

The curd is further drained during the first day of the process, by two or three turnings. On the following morning, when of some consistency, the cloth being removed, its value is determined by weighing. After three or four days, fermentation begins, and the wooden bands are removed. It is then, once daily for eight or ten days, alternately salted on its upper and lower side, 4 ozs. of pulverised salt being, on an average, used per form, or 33 lbs.

The Gorgonzolese adopted some years ago the process of quickly turning and pressing the cheese against a salt-covered surface, thus ensuring more uniformity and a better crust.

The colour changes in a month to pinkish white, if good; to black, if bad. When black the crust is soft and the cheese perishable in summer. If the crust is sufficiently hard, the shade is improved by one or two dippings in salt water.

The time of maturity depends upon the temperature (which is best about 55° Fahrenheit), the manner of making, and the quality of the milk. The Gorgonzolese *Stracchino* begins to ripen in April, and continues until September. One hundred quarts of milk make about 25 lbs. of this cheese.

Bellunese cheese is made by heating the milk, pouring in rennet, letting it coagulate, breaking it into medium-sized pieces, reheating it, putting it in wooden tubs, salting and placing it on stands for daily turning, and resalting until consumed.

The following process makes a kind of Frinlani cheese known as "*Fieno.*" Milk, heated in cauldrons until tepid, is mixed with rennet and left to curdle. The curd is broken in vessels into small pieces, and violently shaken over the fire. When thus crumbled, the cauldron being set on a stand, it is gathered, thrown

into the *talcio* or forming-tub, placed on tables for drainage, dried, and finally immersed in brine.

Other Frinlani cheese is made with milk tepefied in heaters and thence poured into wooden vats for coagulation. The curd formed is wet, broken into large lumps, remoistened with hot whey or water, gathered, and pressed in wooden hoops. It is less solid than that just described.

Parmesan (*Formaggio di Grana*). Milk is poured into cauldrons and placed on the fire. If mature, *i.e.* bluish (as it should be in summer), it is warmed to 77° Fahrenheit; if sound, *i.e.*, retaining the whiteness and sweet taste of freshly milked, it is heated to 86° Fahrenheit. At this temperature, as tested by the hand, it is removed from the fire and mixed with rennet. One-sixth of an ounce of rennet is used per 720 quarts of milk. The rennet is dissolved with a pestle in wooden cups, filtered through horse-hair sieves, the oozing going into the cauldron of milk. To prevent hardness, the curd formed is broken and turned with the cream-turner, *rotilla* (or stock with wooden dish at end), and *spino* (or cane with twisted twigs or iron pins at one extremity). This is continued for three-quarters of an hour, while concretions appearing on the surface are removed by hand. Turning is stopped for two or three minute intervals to consolidate but not harden the now softened or dissolved curd. The whey is removed and one-sixth of an ounce of saffron per 110 quarts of milk thrown into the cauldron. The curd is replaced and left for one hour on the fire, heated to 113° Fahrenheit (but not higher), and continually stirred with the *rotilla*.

A cup is filled with curd for examination as to the minuteness of its particles. If small enough the cauldron is removed, and the curd sinks and forms on its bottom. To hasten this, the cooled whey (before drained off to enable the adding of saffron) is poured into the cauldron, the bottom of which is pressed with the *rotilla* to unite and incorporate the curd. The curd is loosened with a stick from the sides of the cauldron, lifted, drawn on the

surface, collected in a cloth, placed and left for one hour in a vat, and there wetted with whey. It is marked with the name of the owner of that day's cheese, pressed for drainage by hand in a box of narrow beech boards bound with hoops and pack-thread, and covered with linen, a wooden dish, and a heavy stone. When dried, these coverings are removed and it is re-wetted with whey, and then covered with buckram, which, under pressure of the dish and stone, makes reticulated imprints on its circular surface. After some hours the buckram is cut, and the clippings removed to permit the whey to dry in. It is covered and rubbed on an oak bench with salt, dipped in salt water, and re-pressed between the beech boards. Sometimes several forms are simultaneously pressed to improve the under one by the salt moisture from the upper one. It is resalted every other day for two weeks, then put in the cheese-house, where superfluous salt is removed by scraping. In September it is rubbed with cheap oil.

The cows of the numerous dairies of Puglia and Basilicata are milked once daily. Their milk, when poured into large vats, is divided and one half is heated to a point which will make it and the unheated when mixed, and tested by the hand, 100° Fahrenheit. Whey of goat's milk is mixed and shaken in it. While curdling it is covered with a cloth to keep up the temperature. When the curd is set it is broken, stirred with the *rotolo* till in filbert-sized pieces, placed with whey in a vat, rebeaten, wetted, and covered with warm whey to "grow." When by heating on hot coals or boiling in water ductility is obtained, the curd is called "*crescuita*," or grown. This property acquired, it is cut, the pieces thrown into the pail, where they are wetted with hot water, reunited, manipulated, pulled into thread, and made into as many balls as there are cheeses to be made. These thread balls are immersed in the water which served to make them, manipulated till homogeneous and compact, formed by hand into proper shapes, and daily salted for two or three days. Cheese thus made is called "*Caciocavallo di Puglia.*"

The *Caciocavallo* of Calabria is a cow's milk product, prepared by slight modifications of the usual cheese-making process. Upon perfect coagulation entirely depends the result—the caseine gathering at a particular temperature. The *pâte* is formed into its required uniform consistence after stirring and subsequent pressure. It is then subjected to the action of hot whey, removed to a table, worked, placed into moulds, covered with a cloth, and left to the chemical action of its constituent parts. During this time, when fermentation begins, it is cut in slices, which are immersed and shaken in hot water, manipulated to drain off the whey, etc., reduced by water and heat to homogeneity, replaced on tables and rendered soft, adhesive, and ductile by frequent dipping and turning in cold water. In this state it is divided, shaped in oval forms, kept the first day in cold water to produce elasticity and consistency, the next in salt. Thus finished, it is fastened to the end of a stick, and hung from the beam of the cheese-house. Cow's milk, when coagulated and lightly broken, produces a semi-solid excretion or discharge, which forms the essential substance of *Rasco* cheese. This is placed in vats, lightly shaken, dipped quickly three or four times in hot whey, removed, and replaced, when sufficiently solid, upside down in these vats; then kept for twenty-four hours, slightly salted and taken to cool dry rooms for keeping. This cheese is made from June to October, the season when the milk is richest in fat. It is soft, white, and soluble at a low degree of heat.

Sicilian *Caciocavallo* is made of cow's or goat's milk, and coagulated like sheep's milk cheeses. When curdled, it is not heated in water, but broken with a piece of wood, the whey removed, dried, and taken from the tub to the trough. Then the curd is sliced, replaced in the tub, cooked in boiling whey, removed to the trough, pressed to solidity, cooled, placed and left for twenty-four hours on a stand or table, sliced, thrown into boiling whey, recooked till viscid, gathered, pressed, drawn by hand, reduced to paste, formed in pumpkin-shaped pieces, salted

for twenty-four hours, and hung prepared for use in the cheese-house.

Proratura cheese is made of cow's milk. The cows are only milked in the mornings, when their milk is poured into a large pine tub-shaped receptacle. Only when the atmosphere is cold is it previously slightly heated. Dissolved kid rennet is poured into it, the mixture turned with the *rotolo*, and then left quiet. Upon coagulation the curd is not allowed to become lumpy, but is pressed and softened with the *rotolo*. When the curd sinks in the vat, a sieve of pierced tin is placed and held over it with weights. If much whey rises, it is used for *ricotta;* if little, the sieve is removed, and it is left on the curd to facilitate "growth," as before defined. When ductile, it is cut in small pieces, placed in another pine vat, and previously-prepared hot water poured upon it. Here the curd is kept till cooked, when the water is drawn off. It is then, in portions, gathered, and stirred with a wooden spoon, and formed, by hand previously wet in cold water, into two-pound balls, which are put and left for some hours in tubs of cold water, and finally slightly salted.

Butter, when made in families who have little milk, is made in cylindrical churns, in which the cream is shaken by movement of the churn handle. Factories use large cylindrical churns on trestles, in which are wings turned by machinery. The butter they produce is cleaner than that made by hand-churns. In Pavia, cream of 46° Fahrenheit is shaken in round boxes called "*puraggie*." Each box has a spoon fastened to an axle. This axle is turned by a crank, and revolves the spoon around the inside periphery of the box. The process requires two men. Some use a cradle churn, which saves labour and produces equally good butter. In Cremona the American machine is in general use, viz., a horizontally-fastened tub, in the interior of which is a reel similar to that used in silk-making.

The dairyman of Parma beats the milk with a cream-whipper,

and skilfully lets the floating cream, which gathers in the bucket, overflow into a fine-edged wooden bowl, and thence into the churn. In summer it is customary to add 10 lbs. of ice to every 30 quarts of cream, while in winter some cream is heated and turned into the churn with the rest. The temperature is always kept at about 60° Fahrenheit. When in the churn, two men alternately beat the cream with a butter-beater joined to a straining-frame, raising and lowering it by leverage. Butter should begin to form in three-quarters of an hour. When it is necessary to hasten formation, water is added; where advisable to retard it, ice. If made before the time mentioned, it is soft; if after, hard and set. When prepared, it is taken from the churn, worked with the hands, formed into blocks, and left to drain. The blocks are frequently adorned with impressions made with a wooden stamp. The skimmed milk is used for the *ricotta* cheese.

In Catanzaro, butter is made with the old-fashioned churn, a miserable mechanism, causing loss of milk and time. The manner of keeping butter there, though simple, is exceedingly ingenious, consisting in enclosing it in small bladders, in which it can be conveniently kept and carried without danger of change.

At Modica, where the butter is delicious, it is not made directly from the cream, but from the *ricotta* which is obtained by boiling the small milk after extracting the caseine.

The butter-maker of Sardinia puts the *ricotta* in a bowl of cold water, and shakes and presses it between his fingers. In half an hour a white scum appears on the surface of the water, and by continued movement and pressure of the *ricotta*, increases during the succeeding half-hour. This scum is the butter of the *ricotta*.

Dairy Associations and Cheese Factories.—It is difficult to determine the epoch in which the first dairy associations were formed. It is known that they were numerous in Savoy in the Middle Ages,

and that they have existed since remote times in the French Jura and on the Alpine slopes. Where land is owned in small plots, as in the mountainous parts of Upper Italy, and where large dairies consequently do not exist, the making of cheese is impossible, unless assumed by a manufacturer who would buy the milk from the cow-owners, or unless these, in partnership, prepare it.

The advantages of dairy associations and cheese factories are numerous. One cheese-making establishment, set of machines and utensils, answer for many milk-owners, lessen the cost of production, increase and improve the product, facilitate sales, save time, and permit farmers and their workmen to be otherwise usefully employed. These considerations moved the Italian Government to offer in 1873 and 1874, several prizes, of which the highest was £60 and a gold medal, to the best-managed association, under articles of copartnership, organised for the manufacture and sale of butter and cheese, or either, to be thereafter started, composed of at least ten associates having equal rights, working 340 quarts of milk per day, and having a cheese-maker in their sole employ.

Since then cheese factories have greatly increased in number, and improved in management. They are everywhere in Italy except Sicily, where small milk-owners carry their milk to the large, and when, after a month, they have delivered to these 250 or 350 quarts, they receive that quantity back at one time. This system of reciprocal loans is mutually beneficial, as a large quantity of milk, worked at one time, makes more cheese than the same amount worked in small quantities at different times.

SWITZERLAND.

The fame of Swiss dairying is not confined to Europe, which is so well acquainted with its cheese, for America has taken in hand the breeding of the Schwytzer dairy cattle, than which very few

better animals exist. Having explored the dairy districts of Switzerland somewhat closely, and at a time, too, when similar investigations were made by Mr. S. H. M. Byers, the U.S. Consul at Zurich, we have compared notes with his report to his Government, which, if anything, is more favourable to the Swiss than the remarks in this chapter. While we are aware that in butter-making the general body of farmers are not so advanced as our own people, and that the implements and utensils employed in the industry are obsolete, expensive, and inappropriate, yet we cannot deny the value of the system of cheese-making, the milking properties of the cattle, or the common-sense system of feeding which is pursued. So far, it is impossible to obtain any records which would enable a scientific dairyman to make complete comparisons as regards the milking properties of particular herds, whether as to quantity or quality; but an examination of some hundreds of animals, many of which were milked, and the *tout ensemble* of the Exhibition at Lucerne, where some 1100 head of cattle were in competition, the majority being dairy beasts, has led us to consider the Braunvieh, or Schwytzer, one of the first milkers in the world. At this national exhibition this race produced 180 bulls in two classes, 180 cows in one class, and 180 heifers in two classes. At the Paris International Exhibition, in 1878, we noticed a fine collection of Schwytzers, which created considerable sensation among dairy-farmers. The chief homes of this breed are the cantons Zurich, Zug, Schwytz, and Lucerne, although they are found throughout German Switzerland, and we have seen them on the Italian side of the St. Gothard. They are also largely bred and crossed in South Germany.

It will astonish many of those who follow the modern system of high feeding, to learn that the Swiss feed entirely upon hay or grass—it would, in fact, be very difficult to find a farmer who used roots, and almost impossible to find one using corn or cake, for although they admit that high feeding forces more milk, they believe that it lowers the quality, and that consequently nothing

is gained. Straw is almost unknown, and land which grows a species of rush lets as high as £4 an acre, while grass land is excessively high-rented, and is worth from £50 to £80 per acre. The general system which prevails in the Cantons mentioned above in large dairies, is to feed the cows entirely in the stall. In the higher districts, where small dairies abound, they are sent out upon the Alps every day during summer, and all farmers make a practice of turning their young stock out upon the mountains during summer, until they come into the dairy. The stall-fed cow is allowed as much grass as she will eat in summer, while in winter she gets a very good feed of hay. Grass is cut three, four, and sometimes five times during the season, the ground is generally moist, the meadows are well drained and continually being fertilised with liquid manure, which is the real secret of its marvellous yield. That much more grass is grown by this method than could possibly be grown were the animals turned out, is clear; and by this method there are no gaps to stop, no stray beasts to catch, and they are not tormented by flies. The traveller who understands farming will be struck everywhere by the evenness of the meadows, the quality of the grass, its abundance and fertility, and the strange appearance it presents is accountable to nothing more than liquid manure and the absence of the cattle. Mr. Page, of Lanrütli, on the Lake of Zug, who owns one of the finest herd of Schwytzers, while admiring and adopting the Swiss system, has introduced a grass, which side by side with the native plant is clearly its superior; and this is not to be wondered at, for in sowing the Swiss pay little attention to variety, but have devoted years to the improvement of inferior grasses. Manuring is not conducted upon the higher feeding-grounds, but where it is carried out, it is estimated that 1½ to 2 acres (Swiss) will carry a cow—and be it remembered a Swiss acre is only 4444 yards. The byres or stables in which the cows are kept, are similar to many we have seen in Cheshire. They are constructed so as to give warmth to the animals, and to economise space, and while

there is barely room for them to lie down, the ceilings are so low that sufficient air seldom or ever enters them. The walls are very massive, and generally built of stone, and the stalls and passages are usually of the same material and kept very clean. Sometimes there is a door at each end of the building, but often only one, while the only light and air which can enter elsewhere, is through the little holes which are left in the walls for the purpose.

It is believed that this excessive warmth and darkness gives more milk, but the idea may be carried too far when ventilation is impeded, and the atmosphere within consequently rendered unhealthy. Overhead the hay is preserved for winter use, just as it is in many parts of England. The mangers are low and the bedding necessarily scarce, but the animals do remarkably well, although they only see daylight when taken out to water daily. The cowherds are boarded by the farmers, and paid at the rate of from 8*s.* 6*d.* to 10*s.* 6*d.* a week. In Canton Zurich, according to Mr. Byers, the farmers receive 6*d.* for 4 litres (nearly a gallon) for their milk, and this is retailed at 8*d.* The Director of the Anglo-Swiss Factory, to whom we are indebted for much assistance in our inquiries, pays 54 centimes (about 5*d.*) for the same quantity. In a good dairy the average yield of the cows is 10 quarts a day the year through, which is remarkably good. To take a case, a farmer collects the milk from 75 cows and sends away 700 quarts daily, over and above that used by the various families of the owners. In July this is increased to 850 quarts, and it is sold at about 6½*d.* a gallon. Milk which has been creamed at 12 hours he sells at 50 centimes (about 5*d.*) the gallon; cream realising 1*s.* the quart. The best ordinary cows in this district are worth £25 each, and the general rule is for one man to look after a dozen. At the low prices quoted, one of the farmers sold in 1881 nearly £25 worth of milk from each of his 10 cows. Another farmer near with 18 cows which he feeds upon grass and 3 lbs. of shorts (a rare case) daily, costing him an additional 2*d.* a head, obtains daily 12 to 15 quarts throughout the year. He calves his cows in autumn, and

sells the calves at three days at 20*s.* to 25*s.* each. He has only 20 acres of grass (hence the "shorts") and one hand. The cows are groomed daily, as is the general custom. It may be mentioned that, upon all these farms, the fields are thickly studded with fine fruit-trees, which are cultivated with much intelligence.

Among the best herds of Schwytzer cattle is that at the famous Einsiedeln Monastery in Canton Schwytz, where 60 Schwytzers are kept, which average 10 quarts a day for the year; of these, over 20 of the cows give from May to July 20 quarts a day without any food but grass. In this case, many of the animals are sent up to the mountains from May to September, their milk being made into butter and cheese in the huts of the attendants. At the monastery each cowman attends to about 22 cattle, receiving 5*s.* a week and board, and working from 4.30 a.m. to 7 p.m. Here again there is an antipathy to artificial food, which, they believe, reduces the quality of the milk. Upon one farm near Einsiedeln, where the cows are exceptionally good, several of the older ones average 15 quarts a day through the year—one gave 21 quarts for three months after calving and 12 quarts for the remainder of the year. This animal made 21 lbs. of butter per week for three months and an enormous quantity for the whole year, receiving no artificial food whatever. Two or three other animals approached her, and it is noticeable that the owner, who is very proud of his cattle, keeps details of their yield. Inquiry will prove that few animals of any breed in any country have ever equalled this performance.

Coming to the herd at Cham, the property of Mr. Page, Director of the Anglo-Swiss Milk Factory, which here has its head-quarters, using the milk of 6000 cows, we found a different system of housing adopted, and one which, while providing warmth, gives air and light. The large cow-house with its ample stalls is one of the finest we ever saw. It is provided with calf-stalls, horse-boxes for bulls and calving or sick cows. Ventilation is complete, and every improvement which experience can

suggest has been adopted. The cows are of the finest, and many of them cost 1000 fr. (£40) apiece, the largest weighing about 1400 lbs. As an example of what they can do, Mr. Page states that 26 of his heifers with first calf produced in three months (April to June) 28,076 litres, or 12 quarts a head; and he expected that with their next calf they would reach 15 quarts a day. Three of the 2¾-year old heifers gave 10 quarts the year through, and 19½ quarts at their best; while three with second calves gave 24 quarts for three months, maintaining a high average for the year. Here the choicest calves are retained for stock, and the others sold to the butcher. The cows get absolutely nothing but grass and hay, never graze, but are exercised daily, and the owner expects to keep 100 upon 150 acres.

It may here be mentioned that the Cham Condensed Milk Factory (which is more fully referred to in a previous chapter, and which we have twice visited) condensed in 1871 the milk of 5000 to 6000 cows, grass and hay-fed only. They were milked for about nine months, and averaged about 5315 lbs. of milk per cow—19·7 lbs., or 9·8 quarts daily. In the same year the English factory condensed the milk from a similar number of Shorthorns, and these averaged 4668 lbs. per cow, or 647 lbs. less than the Swiss. There may be, and doubtless are, reasons to account for this difference, but the fact remains that the comparison shows the Schwytzer to be a wonderful milking breed; at all events, we were so much impressed with its excellence, that we obtained permission from the Privy Council, and imported a herd which we selected in person. The average fat yield of the factory milk is 3·3, although individual cases reach very much higher figures; while the average milk to butter being about 30 lbs., it follows that the average butter yield will bear favourable comparison with that of any similar number of cows.

In conclusion, the Swiss system points to the fact that with high rents, and without artificial food, they obtain good results, which are chiefly owing to—

1. The breed of cattle.
2. An abundance of sweet grass.
3. The soiling system.
4. Liquid manuring.
5. Running water.

The race of cattle which divides the honours with the Schwytzers is the Simmenthaler, but which, although often used in cheese-making dairies, is better known as the butchers' beast of Switzerland.

BUTTER-MAKING.

One of the chief authorities in Switzerland has loudly complained of the bad quality of much of the butter made in his country. He states that it often appears upon the table either too salt or of bad flavour, without taste, or dirty. Those who doubt this statement, he continues, may be easily convinced by comparing foreign butters with those of his own country. The Parisian tradesmen class the Isigny butter as the best sold in their market; the Gournais coming second, Swiss butter only taking third place. Thus the difference in price between the Swiss and the Isigny butter is from 20 to 40 fr. per quintal (220½ lbs.). The chief causes of the want of quality in Swiss butter, according to the same writer, are: 1. The inequality of temperature in the dairies, and the smells arising from foods stored too close to them. 2. The utensils, which are made of improper materials and of bad construction. 3. Leaving the milk too long a time before it is creamed. 4. The imperfect construction of the churns, which prevents their being thoroughly cleaned. 5. The technical knowledge necessary in the manufacture. 6. The disregard of temperature during churning.

The classes of butter made in Switzerland are: The first quality, or *beurre de crême*, which is made exclusively from cream; second quality, or *beurre mêlé*, which is made from a mixture of ordinary cream and the cream of the whey (this butter is manufactured during summer in all large dairies); third quality, whey-

butter, or *de grasseïon*, also called *beurre blanc*, which is manufactured exclusively from the cream of the whey, and is especially suitable for melting.

The system generally adopted for the separation of the cream is that of cooling with water at a temperature of from 50° to 58° Fahrenheit. For this purpose vessels of wood are used, but, like most of the utensils employed in Swiss dairies, which are made for the most part of fir, although sometimes of pine (*Pinus cenubra*), they are very difficult to clean; at the same time, it

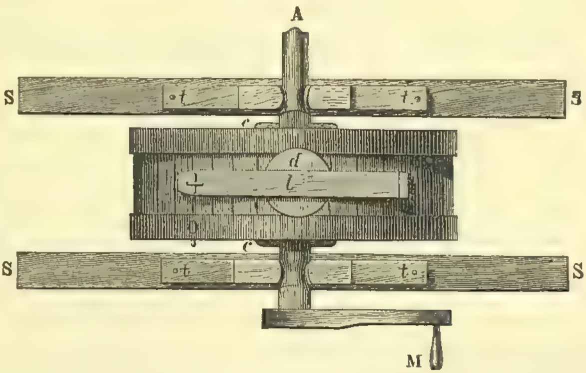


Fig. 156. Swiss Churn. A, Axle; S, Legs; M, Handle; O, Gas Escape; *t t*, Collars supporting Axle; *d*, Lid; *l*, Wooden Bar for fastening Lid.

may be observed that, as far as the eye can see, they are cleanliness itself. In most of the mountainous districts it is the custom to leave the milk from 48 to 60 hours before skimming. This is done because of the greater quantity of butter gained; but the principle is a false one, inasmuch as the quality is necessarily inferior, as it contains a much larger quantity of caseine, and, unless eaten quickly, it rapidly acquires a disagreeable flavour. In churning, the best authorities prefer that the cream should be sweet, for not only does it become butter in less time than sour cream, but the butter itself is much sweeter, although its flavour may not be so full. This fact we have repeatedly proved in

Switzerland, in the best towns of which much of the butter is quite equal to that of Normandy, great care being taken by the dairymen to produce samples of the finest quality for consumption by foreign, and especially English and American, visitors to their country. The principal churns used by the Swiss are the *ordinaire* and the *barrel*, which is very similar to the barrel churns used in England. The best is that of Lefeldt, which works upon patent rollers, is provided with a large circular lid, an air-valve, and three wings in the interior, which are pierced with a large number of small holes. The churn, however, which is most extensively used, and which, indeed, is peculiar to the Swiss people, is one which resembles a millstone or a Gruyère cheese in shape. This churn, the *ordinaire*, is made of the hardest mountain fir, and its diameter is altogether out of proportion to its width, for the latter is not sufficient to provide room for a proper lid; consequently it is most difficult to gather the butter and to clean the churn. This fact is admitted by the best Swiss dairymen, and having brought one of the churns to England, we have been able to prove it for ourselves. It revolves upon a plain stand, and in the interior is either a beater pierced with holes, or plain wooden frames, which answer the purpose equally well.

In churning, the cream is generally put into the churn at a temperature of 59° Fahrenheit, the operation generally taking from half-an-hour to an hour, the makers preferring never to hurry the work, for if the butter forms too quickly it is much too soft in grain, and does not realise the best price. They are generally careful to stop churning at the right moment, in order that it may be cleaned while in a firm, granular form, for if churned until it becomes a solid lump, much of the buttermilk is left in it, and as almost all Swiss butter is made without salt, they are compelled to exercise great care, in order that it may keep sufficiently long for their customers' consumption. The butter made in winter in most parts of Switzerland is coloured with a mixture of orléans and curcuma; sometimes, however, a solution

of roucou (*Bixa orellana*) is used instead. As most of the butter in Switzerland is used in a sweet, entirely unsalted state, it is often necessary to preserve it; large makers consequently construct a *glacière*, or ice-house, in which, with the assistance of ice (which they obtain at small expense during their severe winters), they are enabled to keep it for any length of time. It is generally estimated that 2½ to 3½ per cent. of butter is obtained from milk which has stood 24 hours; in other words, they obtain about 10 per cent. of cream, which generally yields the above quantity of butter.

Beurre blanc or whey butter is largely manufactured, as it is in our own cheese-making districts, and until the discovery has been made how to obtain all the fat from the milk in cheese-making it will no doubt continue to be made. In the process of manufacture the whey is put upon the fire and gradually heated to 194° Fahrenheit, when they add about 1½ per cent. of a prepared rennet, which at first causes a light layer of froth to appear on the top, after which the cream quickly forms and is taken off with a skimmer. We have seen this process from beginning to end, and we are surprised that English cheese-makers should continue to adopt the old system of setting the whey for cream, when they can obtain it in a few minutes by the above method. Much of this whey butter is mixed with the best samples and sold at the best price, but this could not be done in England, where happily buyers are too experienced, even if the makers have the disposition to impose upon them.

Cheese.

Cheese-making has been practised in Switzerland since the earliest times, but it is only some sixty years ago that it commenced to constitute one of the most important branches of agricultural industry. The best-known Swiss cheeses are: *Emmenthaler*, *Gruyère*, *Spalen*, and *Gessenay*, being all hard makes, and *Bellelay* and *Vacherin*, which are soft. Cheese is

also divided into three classes, according to the amount of fat contained in it, viz.: fat cheese, made principally in the summer, from whole milk; half-fat cheese, made in the spring and autumn from half-skimmed milk; and lean cheese, made in the winter from skim-milk.

Emmenthaler is made in the following manner: after the formation of the curd, the rennet is added to it, an important operation which we must describe in detail.

Rennet is made from the stomachs of young calves, and nothing else has as yet been found which is so useful for making the milk coagulate as this liquid, although many experiments have been made. There are three qualities of stomachs, varying from a year old or over, to three months, and the prices run from four-pence to four shillings apiece. For the preparation of rennet no other stomachs should be used than those of healthy calves; they must have no bad smell or other defects; and the calves must not have been fed on anything else but milk. The stomachs must have been carefully dried and preserved, and should not be kept longer than a year. It is the best plan to use pieces of divers stomachs, and the rennet should not be prepared a long time in advance, as it spoils rapidly. The pieces of stomach are kept in soft water for thirty hours before they are used to make rennet. After cutting off and throwing away the two ends and the fat parts, they are cut into pieces and mixed, and then put into basins or other vessels, when water is poured on at a temperature of 90° Fahrenheit. At a lower temperature the rennet will not be strong enough, and at a higher it will be too strong. The proportions are a gallon of water to 28 drachms of well-dried stomach-pieces. The rennet thus prepared is preserved in a place where the temperature is 90° Fahrenheit. It has been proved that 220 parts of milk are coagulated by one part of this rennet in 18 minutes. The effects of the rennet upon the milk are determined by the following conditions:

The milk which comes from one milking offers no difficulty, being all of the same nature, but when of two different milkings, as in the making of fat cheese, the treatment is more complicated. The evening milk is put into large pans, to be skimmed in the morning, when the cream is put into the boiler with a little water and heated to 175° Fahrenheit, in order to make it into one homogeneous liquid. Then the morning's milk is put into the boiler, and afterwards the evening's skim-milk. The greatest attention should be paid to the degree of heat required, and the thermometer should therefore be constantly used. The coagulation will take place more uniformly if the boiler be covered with a wooden lid, in which a hole should be made which can be opened and shut, to allow the thermometer to be passed through. The proper temperature of the curd for the mixing of the rennet is 93° Fahrenheit, or, if the milk is very rich, 94°; in the summer, however, it may be somewhat lower. The process of coagulation should be carefully watched, and regard be had to the quality of the milk, the season of the year, the daily temperature, the feeding, etc. The milk should be daily tested with the lactometer, when it will be found that during rainy weather it often contains more water than it ought to do, although it has not been adulterated. Sometimes the milk curdles very rapidly, and with a buzzing sound, especially when it is not quite pure, but generally it takes about 25 minutes, and if a homogeneous, gelatinous substance has been formed, on which an impression is left when some object is brought into contact with it, the work of coagulation may be considered as successfully finished.

Next follows the transformation of the curd into cheese, which process is commenced by cutting up the mass with a wooden knife, which reaches to the bottom of the boiler, after which it is manipulated with a long-handled wooden skimmer in such a manner that the bottom pieces are brought to the surface, and *vice versâ*. The whole mass is then slowly stirred, the operator

taking care not to do it quickly, or minute flakes of curd will remain in the whey and thereby prove that the work has not been

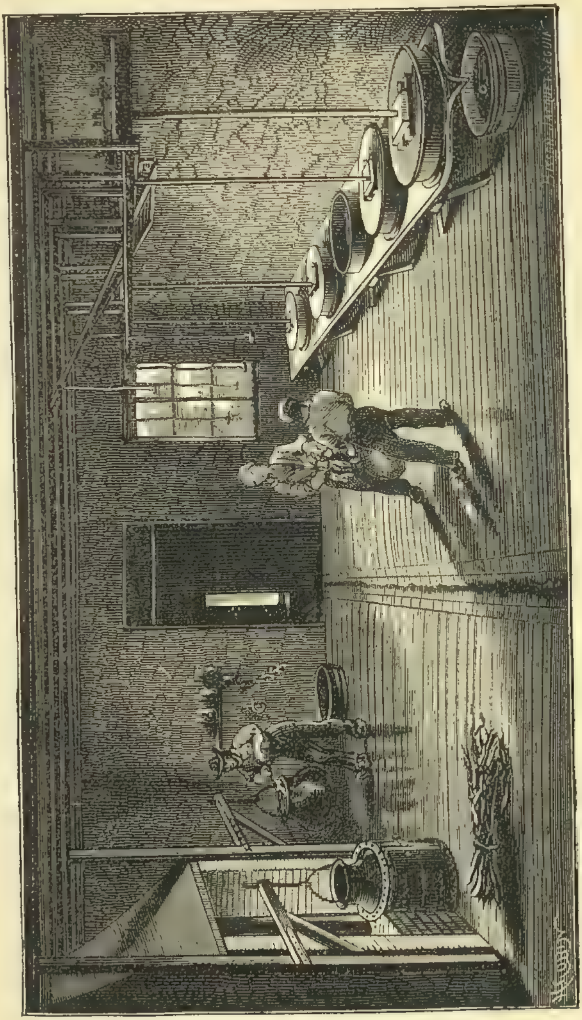


Fig. 157. Gruyère Cheese-making at the farm of M. Lecomte at Villeblevin.

done properly. This stirring is continued until the whole mass has been changed into small pieces of the size of peas, when it is

left alone for 10 minutes. A hot fire is then made, and the mass stirred again until it acquires a temperature of 136° Fahrenheit, when the boiler is lifted off the fire, and the stirring continued until the pieces have acquired the necessary elasticity and cohesion, the exact time being carefully watched by the maker. It generally takes about 50 minutes for the curd to reach this stage. The contents of the boiler are next stirred very quickly, and in such a manner that a funnel-shaped cavity is formed in the centre, after which it is left to settle itself, the solids sinking to the bottom, and the whey floating on the surface. The curd must be manipulated until it acquires such a consistence, that, when taking a little out of the boiler and pressing it in the hand, the pieces do not adhere to one another when the hand is reopened. If the pieces are too soft, they will, during the second process of heating, acquire a hard surface too quickly, and retain in their interior a quantity of whey, which cannot be pressed out. In ripening, such cheese would show a great many small holes, and fetch a much lower price. If the milk has been heated too much during the coagulation, or if too much rennet has been put into it, the curd pieces become too hard *before* the second heating, and consequently too hard *during* that process; the cheese does not then fully absorb its juice, and shows no holes, or eyes, as they are called. As cheese-making is a matter of experience, it is not possible to indicate all the measures of precaution to be taken, yet there are some important rules which intending cheese-makers should understand. The higher the temperature is, whilst stirring the mass of the cheese, the firmer and more lasting it will be, but also the longer will it take to ripen, and *vice versâ.* This causes the great difference between hard and soft cheeses. Certain kinds of cheeses are only heated once; they are made either of cow's or goat's milk, and are called *vacherins*, goat-cheeses, etc. They are easily made, and eaten as dainties in France and in some parts of French Switzerland. As regards lean cheeses, they are made in the same way as described, only at a lower degree of heat, and still greater

carefulness is required. In order to lift the curd out of the boiler, a cheese-cloth is taken by one of its sides, which is folded round a wooden or iron rod of the shape of a half-circle. This is held by the two ends and passed along the bottom of the boiler or cheese-kettle, thus enveloping the curd, which is lifted out and placed into the mould, cloth and all. When the curd is heavy, a pulley is used, fixed to the ceiling between the boiler and press; the four corners of the cheese-cloth are tied together and fastened

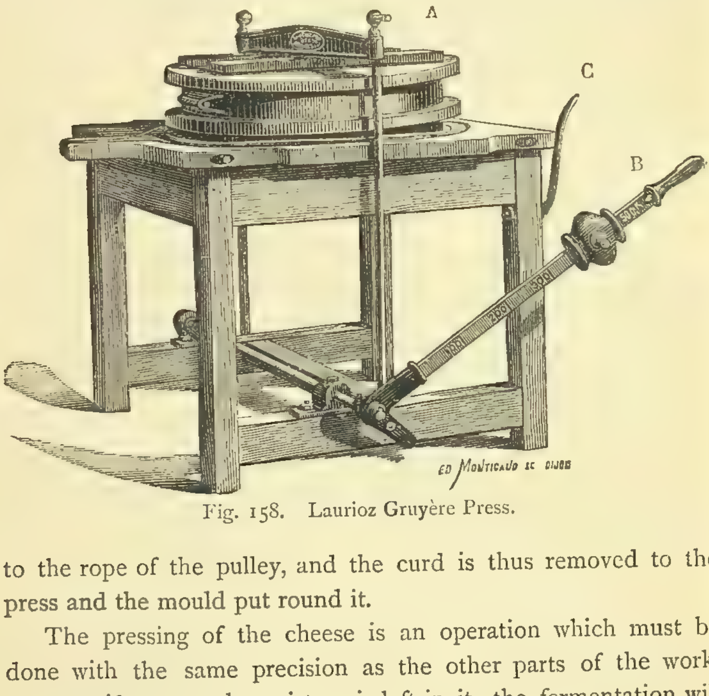


Fig. 158. Laurioz Gruyère Press.

to the rope of the pulley, and the curd is thus removed to the press and the mould put round it.

The pressing of the cheese is an operation which must be done with the same precision as the other parts of the work, because, if too much moisture is left in it, the fermentation will take place too rapidly, and it acquires a tallowy taste; if too much moisture is pressed out, no fermentation will take place at all, and it will be tasteless. Numerous experiments have shown that the proper pressure required is eighteen times its own weight.

One of the best presses employed in the manufacture of

Gruyère is that made by Laurioz, and shown in Fig. 158. By means of the lever, as can be seen in the engraving, almost any required pressure can be given to the cheese, which is placed in its mould between two wooden boards. In working, the cheese is placed in the centre of the table under the iron horizontal bar A, which is connected with the lever B. There is a circular gutter in the table to catch the drainage and carry it off, as shown on the left hand.

We left the curd at the moment that it was placed on the bottom of the press. The mould is now closed in such a manner that the curd, which should be well arranged in the cloth, and without folds, projects slightly over its edge, and then commences the pressing. During the day of making, the cheese should be turned five or six times, and each time enveloped in dry cloths, also, if required, the mould must be tightened. The dry cloths act as sponges and absorb the excess of whey, also giving the cheese a nice form. Next day the cheese is taken out of the press and placed on the cheese-table to be salted.

In large dairies there is generally one large cheese warehouse, on a level with the room in which the cheese is made, and in addition an underground apartment or cellar. Both should be lofty, in order to obtain two different kinds of air: one near the ground, where the air is cool and dry; and one near the ceiling, where it is warm and damp; the influence of the air on the cheese being a very active one. By means of the thermometer and warming apparatus, the temperature for ripe cheeses must be kept at 60° Fahrenheit during the first period of fermentation; at 57° during the second period; and at 52° during the third period. It must never freeze in a cheese warehouse, because frost hardens the crust, spoils the colour, and prejudices the fermentation, on which depends the success of the salting. The ventilators should be so made that they can be closed hermetically, for sometimes one single cold north-east wind will completely spoil a whole warehouseful of cheese. In summer a cool current of air

is necessary when the cheese threatens to puff up by too active a fermentation. Sudden changes of temperature must be avoided. As some cheeses are very heavy, it is convenient to have a movable table for salting purposes, one which can be raised or lowered. In the beginning the cheeses must be salted every day, then for several months every other day, and later on for some months twice or thrice weekly, till they refuse to absorb any more salt. The larger and thicker the cheeses, the longer they require salting; sometimes the operation lasts a year or longer. The quality of the cheese can be examined by means of a probe. Lean cheeses require quite as much care as fat ones, but they seldom receive it, and this accounts for the inferior quality found in the market. In the absence of precise investigations we must content ourselves with a rough estimate as regards the quantity of salt required; it is generally put down at 5 lbs. to a quintal (220½ lbs.) of cheese. It is the fermentation which gives to the cheese its peculiar flavour, and this process is called ripening. The rennet first stimulates the fermentation, which entirely modifies the chemical constitution of the various component parts. In order to ensure successful fermentation, it is necessary to heat the curd and press the cheese properly, to attend to the required temperature and to the salting.

In the Scandinavian countries the cheese is salted as soon as it is made; the whey is removed by means of a curd-mill, then the salt is thoroughly mixed with it, and the cheese is pressed a second time. It is not salted again in the cellar, and not only is a more regular and rapid fermentation obtained by this method, but the cheese is ready for the market in two or three months.

Returning to the *Emmenthaler*, we note that the numerous little holes or "eyes" are caused by the development of gas; their number depends upon the way in which the curd has been cut up; the smaller the pieces, the fewer the holes. Good *Emmenthaler* should possess the following qualities: the substance should be homogeneous, of a light yellow colour, without cracks,

and with eyes of one-eighth of an inch in diameter; the interior of the eyes should be moist, brilliant, and contain a little brine; the cheese must not be hard and crisp, but melt in the mouth; it should have a fine, slightly sweet, piquant taste, and leave a fatty impression upon the palate. Good lean cheese has more and smaller eyes, and the substance is harder and more brittle.

Gruyère.—This kind of cheese is made in the canton of Vaud, in Savoy, and in Eastern France and other countries. It is not a wholly fat cheese; the evening milk is skimmed the following morning and mixed with that morning's milk, thus producing a liquid two-thirds fat. A cool dairy leaves a larger percentage of fat in the milk than a warm one, and the

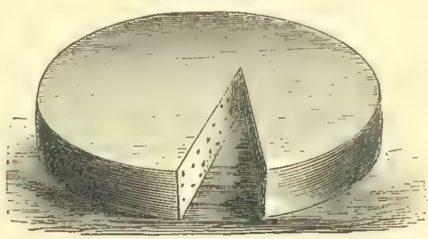


Fig. 159. Gruyère Cheese.

temperature should therefore be properly regulated, especially in the months of August, September, and October. The making is conducted in the following manner: The morning milk is heated in the boiler to a temperature of 109° Fahrenheit, the milk of the previous evening is then skimmed and added to it, which reduces the temperature to 91° Fahrenheit, this being exactly as required for the addition of the rennet. When the *Gruyère* dairyman wishes to test the strength of the rennet (and he does not like it strong), he adds one spoonful to three spoonfuls of milk, and if the milk curdles in 70 seconds, it is considered to be good. The weakness of the *Gruyère* rennet is owing to the manner in which it is prepared. The vessels in which it is made are placed in rooms of a temperature of 61° Fahrenheit, and the first day

1½ lbs. of water of a temperature of 70° Fahrenheit, and 6 drachms of pieces of calf's stomach, are put into a basin; such a quantity is considered to be sufficient for 800 lbs. of milk; the second day 1½ lbs. of boiling water are added to the first day's liquid, and the third day it is used for cheese-making. In about 38 minutes the milk will coagulate, one part of rennet being used to 140 parts of milk. After cutting up the curd in the boiler in the usual manner, and stirring it with the *brassoir* (a wooden stick, 4½ feet long, traversed at one foot from the end with wooden pegs), the fire is lit again, and the mass heated to a temperature of 131° Fahrenheit. Meanwhile the maker constantly stirs it with a uniform motion, neither too quick nor too slow, until it is sufficiently solid to be lifted out of the boiler. This is done in the same way as with the *Emmenthaler*. It is then placed into the mould, and pressed for twenty-four hours. The cheese-moulds used for the *Gruyère* are very similar to those of the *Emmenthaler*, only less wide. The *Gruyère* is salted in the cellar, and not above the ground as the *Emmenthaler*. Single cheeses are never heavier than 75 lbs., and so there are no special cheese-lids or tables required in the cellar. After being salted and washed, they are put back into their places, and the dissolved salt is uniformly spread by means of a woollen rag. The cheeses are turned daily during the first month, and later on every day. After four or six months of daily care, they are ripe, and ready for the market. The half-fat cheeses go mostly to Piedmont, and the best fat to France. A good *Gruyère* has a soft, fine substance, and few eyes.

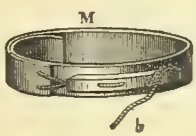


Fig. 160. Gruyère Hausse, or Form.

As regards the quantity of cheese which can be made from milk, it is estimated that 100 parts of whole milk produce 9½ parts of fat cheese; 100 parts of skim milk, 5½ parts of lean cheese; and 100 parts of butter-milk, 6 parts of the same.

Vacherin.—This is a kind of cheese much consumed in French

Switzerland; it is distinguished in two qualities, viz.: hand-made, which is eaten raw, and machine-made. Hand-made *Vacherin* is made from whole milk, heated to 102° Fahrenheit; it is coagulated in the same way as *Gruyère*. The curd is then cut and left to rest for one hour. The whey is next removed and the mass taken out of the boiler and placed in the mould, where it is left to drip for a quarter of an hour. It is then wrapped in a cloth and lightly pressed, the cloth being renewed four times a day. The following day the cheese is placed in a fresh mould called a *sangle*, and rested on a linen cloth which is changed every other day when the cheese is being turned. Machine-made *Vacherins* are made in a similar way; the milk, however, is heated higher; it is stirred, and the whey left on it a little longer, and when finished it is sounder and keeps much better.

Spalen cheeses are very much made in Switzerland, and the manufacture is not confined to any particular canton; they are both fat and half-fat. The *Bellelay* is a very fat, rather soft white cheese wrapped in tinfoil. The *Romatour* is a fat cheese made in squares like the *Limburg*, which it resembles in appearance, taste, and smell, but it is smaller. *Saanen*, again, is made fat, half-fat, or lean, in which form it is grated. It is loaf-shaped, and sometimes resembles Stilton in appearance; in other cases it is chocolate or black, and as hard as it is possible to be. We have examined some called *Reib käse*, made very fat, which were six years old. The *Appenzeller* is a strong, small, flat, round cheese. The *Oberländer* is made in small square cubes. *Stracchino della Puglia* is a very fat, square, flat cheese, made in Italian Switzerland. There are also *Reussthaler*, *Schächenthaler*, made in Canton Uri, and *Alpes St. Gotthard* or *Battelmatt*. All the above were exhibited in force at the great Lucerne Exhibition, where we examined and tasted many of them. We were also pleased with a *goat's* milk cheese, resembling rich *Camembert*, which we have subsequently seen in the Rhone Valley, where it is largely made.

Zieger, or *Schabzieger*, is made in very large quantities in many of the cantons, and is sold in different forms, although it is generally conical. It resembles lumps of soft curd, but it varies in colour, and we remember seeing a lot which was of a drab tint, shaped like flower-pots of different sizes, and priced 43 fr. the 50 kilogrammes. This was made at the rate of 95 to 100 lbs. from 300 quarts of milk, 4 lbs. of salt and 1 to 1¼ pounds of Kräutersamenklee (the special herb used) being added. *Schabzieger* is the product of skimmed milk, and the better it is skimmed the better the cheese, which is made as follows :—Sweet skimmed milk is heated to boiling point, when a quantity of cold buttermilk is taken and added gently until the mixture is nearly as hot as before. Some sour whey (*azi*) is then sprinkled on the top, and the kettle is removed from the fire, when it will be seen that the whey has caused the top portion of the liquid to curdle. The curds formed are removed with a large spoon, the liquid is then stirred, more azi added in quantity according to its strength, until the precipitation of curd is complete and the liquid quite clear. The curd should be soft and of an agreeable sweet taste; it is cooled in buckets and then placed in little tubs to ferment, being subjected to a heat of 15° Centigrade (59° Fahrenheit). It is estimated that 60 lbs. of skimmed milk will make 7 lbs. of *Zieger*. When fermentation is complete, the mass is ground in a special mill, salt and the proper proportion of the clover, *Melilotus cœrulea*, being added, the latter being finely pulverised. It is now placed in the moulds and left for a week, when it is taken to the shelves of the ripening-room, where it remains for 6 or 8 months. In eating, *Zieger* is grated and usually mixed with butter or sprinkled over buttered bread.

CHAPTER XXII.

BELGIUM AND HOLLAND.

BELGIUM.

ALTHOUGH Belgium is not a dairying country in the proper sense of the word, which signifies to British ears extensive cheese and butter manufacture for foreign and especially English markets, yet it has a most important milk-producing industry, and will probably bear comparison with any other European nation, both as to the number of cows kept and the quantity of milk produced, more especially in some of its provinces.

According to an official return, the district of East Flanders contained, in 1866, 270 properties of less than 1 acre; 203 of 1 to 2½ acres; 172 from 2½ to 5 acres; 88 from 5 to 7½ acres; 63 from 7½ to 10 acres; 29 from 10 to 12½ acres; 92 from 12½ to 25 acres; 40 from 25 to 50 acres; 9 from 50 to 75 acres; 3 from 75 to 100 acres; 2 from 100 to 125 acres; 1 of more than 125 acres. There are in this commune some 300 small farmers, most of whom own their own house and one or two cows, and only two have more than six.

In the other parts of the country large farms predominate. The numbers of occupations of more than 10 acres in Belgium in 1866 were: 22,165 of 10 to 12½ acres; 52,650 of 12½ to 25 acres; 30,996 of 25 to 50 acres; 9,967 of 50 to 75 acres; 3,982 of 75 to 100 acres; 2,117 of 100 to 125 acres; and 5,527 of 125 and more acres. The occupations of less than 10 acres amounted to 616,603.

In 1878, there were in the country 738,732 cows, 214,754

heifers, 51,502 bulls and oxen, 143,168 calves under 6 months, 64,289 young bulls and steers, or 17 heads of cattle per 100 acres, 10 of these 17 animals being milch-cows. A large proportion of calves are slaughtered very young, and those that are reared rarely get whole milk for more than a week or two, for which reason there is a greater proportion of milk available for human consumption in Belgium than is the case in Great Britain. It is even estimated that the available home supply of milk and its products, per head of the population, is twice as large in Belgium as in Great Britain.

The following table shows the numbers of cattle in each province of Belgium in 1876:

Provinces.	Two years old and under, including Calves.	Above two years old.	Total.
Antwerp	47,000	80,000	127,000
Brabant	56,000	123,000	179,000
West Flanders ...	64,000	106,000	170,000
East Flanders ...	82,000	116,000	197,000
Hainaut	42,000	101,000	143,000
Liége	36,000	77,000	114,000
Limburg	37,000	57,000	94,000
Luxembourg ...	52,000	71,000	123,000
Namur	35,000	60,000	96,000
TOTALS	451,000	791,000	1,243,000

In the Campine, which is a sandy district comprising nearly the whole of the province of Antwerp, and two-thirds of Limburg, the farms in the neighbourhood of towns are generally from 10 to 15 acres in extent, but in remoter parts from 25 to 30 acres or more. As labour is scarce, there is a tendency to subdivide farms, to most of which some heath or peat land is attached. According to the distance of the farm from a good market, the milk—for the cow is the animal generally kept—is either made into butter or used for fattening calves. The cattle get their first feed at 5 o'clock in the morning; it consists of a lukewarm broth made of turnip-tops, a few turnips, some weeds, cut grass,

a very little rye-meal, a little rape-cake, and plenty of water. At 9 they get some cut grass, at 12 another broth like the one in the morning, at 2 some more cut grass, at 7 some broth and grass. They are milked at 5, 12, and 7 o'clock. On farms of some 50 acres, where 10 animals are kept, the broth-kettle holds about 50 gallons. It is only half filled each meal in summer, but in winter it is quite filled, to make up for the want of green feed; each animal getting 6 gallons of broth per day in summer, and double the quantity in winter. For 10 animals, the allowance of cake per day is, in summer, 1½ lbs., and of rye-meal 1 gallon, and in winter, 3 lbs. and 2 gallons respectively. In winter, the other ingredients of the broth are chiefly hay and turnips. About the middle of September, the cows when in the field go on spurry instead of grass, and live as much as possible on that food and the soup until the frost destroys the spurry, this vegetable being sown as a catch-crop after rye, instead of turnips.

For the purpose of saving the first cost of good machinery, the farmers use primitive contrivances entailing continuous labour, as will be seen from the following particulars.

In most Campine farm-steadings, and some parts of Flanders, the cow-house immediately adjoins the living-room, by which arrangement it is intended to save fuel for the cooking and keeping warm of the cattle food. A long wooden crane, resting against the centre of the back wall of the living-room, carries the broth-kettle from the fire into the cow-house. The kettle is attached to the arm of the crane by means of a chain fitted with an iron screw-rod, which passes through the centre of the handle, thus allowing the kettle to be raised or lowered. The fire-place is situated at the side of the living-room opposite to the door leading into the cow-house, in order to prevent the draught from blowing incandescent wood ashes into the stable straw or other easily inflammable material. The cooking for the cattle is done immediately after the preparation of the meals for the household, and so the same fire serves for both purposes.

Of late a new system of cooking has been introduced, differing from the old method in this respect, that, instead of having the fire-place as far away as possible from the door leading to the cow-shed, it is placed immediately in front of it. Consequently, instead of an enormous crane, a small strong iron bracket will suffice to swing the kettle from the fire-place into the cow-house. On the other hand, however, there is greater danger that sparks of fire may, through the draught of the door, be blown about the room. On some model farms the cooking and steaming apparatus are of still greater perfection, some of them being rather too expensive, and therefore not used anywhere else.

The average rent of farms in the Campine district is 18*s.* per acre. On farms of about 75 acres, a dozen cows are kept; all the calves and another dozen are purchased, and annually fattened off at about 2 months old, weighing from 2 to 2½ cwt.

In the Ypres district the cows are fed chiefly on bread and brewers' grains with straw; they also get beans in winter and clover in summer, besides a certain amount of pasturage. The average annual expenditure for brewers' grains is £100. Milk is bought by itinerant dealers, who go to the farm with little carts full of cans drawn by a dog; they pay 6¾*d.* per gallon. Individuals purchasing small quantities of milk at the farm for their own consumption pay at the rate of 9*d.* per gallon. The wages of labourers are from 8*d.* to 9½*d.* per day with food, winter and summer. In the district of Dilbeck there are about 100 farmers and cowkeepers who take their milk into Brussels every day. These grow fruit and vegetables on their arable land, with just enough corn to furnish bread for their household and straw for their cattle. They reckon that on an average a cow yields about 2*s.* 4½*d.* worth of milk per day, while in milk, and for 5 months in the year they have to spend 1*s.* 7*d.* per day for artificial food, chiefly brewers' grains. It is estimated that a cow gives on the average 3½ gallons of milk per day. The milk is drawn twice daily; the evening's milk is lightly skimmed in the morning, and the morning's milk added as

it comes from the cow. This mixture is sold in Brussels at 20 centimes the litre (9*d.* a gallon), so that a cow's daily yield of 3⅓ gallons realises 2*s.* 6*d*; or if the milk is not skimmed at all, about 3*s.*

Generally the small farmer's wife or daughter takes the milk into town in brass pitchers, which are stowed in a little dog-cart. The large farmers have contracts with hotels or other large houses in Brussels, instead of selling to dealers, as is the custom in the neighbourhood of some other towns.

As to labourers' wages, their daily pay varies from 1*s.* in winter and 1*s.* 3*d.* in summer in parts of the small farm districts, to as much as 2*s.* 6*d.* per day in the neighbourhood of large factories and mines. Men boarded and lodged in the farm receive from 16*s.* to 20*s.* per month in Flanders, and from £10 to £16 per annum in the regions where larger farms prevail. On most farms there are a certain number of boarded labourers, some of whom are lodged; shepherds never leave the sheep and cow-herds never leave the beasts. The latter sleep in the cow-houses on a shelf-bed, or a kind of board hammock swung from the roof or ceiling. Boarded labourers in Flanders generally get rye-bread, lard and buttermilk for breakfast; potatoes, buttermilk, haricot beans boiled in their shells, or carrots or turnips, with rye-bread, and occasionally a little pork or bacon for dinner; for supper they get rye-bread, lard, potatoes and buttermilk. Many farmers live just as their labourers do, and eat with them.

With regard to the various systems of butter-making, it is generally considered that the good quality of Belgian butter is more attributable to the good pasturages than to care in the manufacture. In the polder districts it is the practice to cool the milk by water pumped up from a well into a tank in which the milk-cans are suspended. The milk is not skimmed, but it is left to stand for 24 hours, when the skim-milk is drawn up from beneath the cream by means of a syphon. The cans are washed out with skim-milk, and this mixture of cream and skim milk is added to the

cream; the whole is then left to rest for 2 days, during which time it becomes more or less sour, and mixed with curd.

In the sandy regions of Flanders the milk is not skimmed at all; it stands 48 hours, when it is generally sour, and is then churned in a small upright piston churn, in which it takes one hour and a half for the butter to come. Most farmers are averse to changing old practices, and consequently the management of the dairy generally is far from being perfect, whereas owing to the demand for milk in the towns, the making of butter does not receive so much attention as would otherwise be given. In the eastern district the cows are milked three times a day. The milk is set in shallow pans for 30 hours, when it is skimmed, and the cream is placed in earthenware vessels and kept cool. In summer churning is done twice a week, and in the other seasons once a week. The butter comes in about 25 minutes, and is not washed in the churn, but immediately after being taken out. The churn generally used is the barrel, fitted with fixed dash-boards, attached to the circumference, but not extending to the head.

The cows are fed in winter entirely on hay until they calve, which is between February and April; after calving they get each about 10 lbs. of bran—or 7½ lbs. of meal and 2½ lbs. of bran—in addition to their hay. They lie on a brick floor, and the dung and urine fall into a brick trough behind them. Both heifers and bulls are mated when 15 months old, and calves when very young are sold for 16*s.* to 20*s.* each. On farms of some 30 acres all the work is done by the farmer and his wife, one man-servant and one woman-servant, the two latter receiving £12 and £8 respectively per annum with food and lodging.

The celebrated *Limburg Cheese* which is largely made in Belgium, is made either of whole or skim-milk, which is warmed to the same temperature as it had when drawn; the rennet is then mixed with it, and the curd taken out after 40 minutes. Next, the curd is placed into wooden or tin square moulds perforated at the sides and bottom, in which it is left to drain for

some time; when firm, it is turned out on a board for 24 hours, and salted on all sides; after a few days the young cheeses are taken to the curing-room, which should be airy, and here the cheeses are dried and coloured on the surface. As there is very little manual labour required in making, these small skim-cheeses can be sold at as low a price as $2\frac{1}{2}d.$ each; and whole-milk cheeses of the same size at $5d.$ each. This cheese, which is also made in Bavaria, Alsace and Lorraine, and North Germany, is very popular. We saw it made in Brunswick, where 900 litres of milk were heated to 90° Fahrenheit (32° C.), 100 grammes ($3\frac{1}{3}$ oz.) of rennet being added to every 100 litres, with 3 grammes of annatto. The mixture is then covered for half-an-hour, when it breaks and is cut. When sufficiently drained it is put into perforated wooden moulds 4 inches square, allowed to stand a certain time, and then salted once a day for 4 days, when it is put into the dark curing-room or cellar, and is ready to eat in 3 weeks, being examined and turned two or three times only. It takes 3 litres of milk to make a cheese weighing $\frac{3}{4}$ pfund ($1\frac{1}{10}$ lb.), costing 25 pfennings ($3d.$).

PRICES OF CONVEYANCE OF EGGS, BUTTER, ETC., FROM THE FOLLOWING STATIONS IN BELGIUM TO LONDON (*viâ* HARWICH).

From	By fast train. Price per 2 cwt.		By slow train. Price per 2 cwt. Butter and Eggs. Full and incomplete charges.	
	s.	d.	s.	d.
Alost	5	11	2	9
Boitsfort	5	11	2	9
Braine l'Alleud ...	6	2	2	11
Genappe	6	4	3	1
Groenendael ...	6	0	2	11
Hal	6	1	2	11
La Hulpe... ...	6	1	2	11
Malines	5	5	2	7
Nivelles	6	3	3	0
Ruysbroeck ...	6	0	2	11
Waterloo	6	2	3	0
Wavre	6	3	3	0

Mr. H. M. Jenkins, from whose report we take the above figures, says that there really is but one line of conveyance available for perishable commodities which are bulky and will not bear heavy expenses of transit, namely, *viâ* Antwerp and Harwich, and by Great Eastern Railway to London, as the charges on the mail route *viâ* Dover and Ostend are reckoned by the pound.

Taking Ipswich as the centre of an agricultural district in the Eastern Counties, and about the same distance from London as the intermediate station (Harwich) on the route to Belgium, it is found that the rate for butter, eggs, etc., from Ipswich to London is 4*s.* 9*d.* per cwt., including delivery within the usual limits, while the rate for the same articles by "Grande Vitesse" from stations as far south of Brussels as Gembloux, does not exceed 3*s.* 2*d.* per cwt., provided that at least 4 cwt. is sent at one time. By goods train the charges from Ipswich are: Butter, casks, etc., 11*s.* 8*d.* per ton; other packages, 21*s.* 8*d.* to 36*s.* 8*d.*, including delivery in London. These figures leave no doubt that the British producer is placed at a great disadvantage.

Holland.

There are few persons who know anything about dairying who do not know something about Dutch cows, but it is to be feared that there are not so many who understand the systems adopted by the intelligent farmers who produce them, whether it be with regard to their management of cattle, or their manufacture of butter and cheese. In a word, we understand Dutch products as we know them in England, but not the methods of their production. Holland is really a dairying country, and it has managed to produce a race of large milkers, very saleable cheese, and good butter, to say nothing of the imitations which its factories send us over in such huge quantities. The chief districts are North and South Holland, and Friesland, all of which have their specialities. In the first-named the famous *Edam* or round Dutch cheese is

made, together with the well-known Kampen butter; in the second the *Gouda*, or flat Dutch, and Delft butter, while in Friesland very good butter is manufactured, although efforts are being made to produce a better article.

In North Holland the course of procedure among dairy-farmers is as follows. The best calves are reared, and the others sold at a month old. The grass is particularly good, and an enormous quantity of cattle is kept on small farms; indeed, throughout the Netherlands the number per acre is far higher than in any English county. The farmers are especially clean in their work, and the dairies are model hives of industry. In a few instances the *Swartz* system is adopted, but generally the open milk-pans are used. The *Edam* cheeses yield about 6*d.* a pound, and are made in sizes of a little over 4 lbs. each.

In South Holland—where the land, though very good, is very dear, and intersected by myriads of dykes—cattle can often be fatted on the pasture. Nearly one-half of the grass is mown for winter feeding, the cows getting a little oil-cake in addition, the oldest being annually fatted off, and forming, next to the all-important cheese, the chief item in the list of receipts. In South Holland too, a cheese which is called the *Derbyshire*, is also largely made, and we are told that the richest go to France, the best to England, and the inferior to Scotland. On a farm quoted by Mr. Jenkins, of 750 acres, half of which is grass, 160 cows are kept, the calves being sold at a week old. The yield of milk is estimated at 660 gallons per cow; 1 gallon making very nearly 1 lb. of cheese. A pig is kept to each cow, and this is fatted on the whey mixed with barley or maize meal. In the Delft butter district the land is chiefly grass, and, where let, the rents sometimes reach £4 an acre. It is manured to the extent of one-third annually, and about this quantity is mown, although the rule does not hold good in particular cases. Generally speaking, 1 cow is kept to every 2 acres. In some cases Mr. Jenkins, upon his visit as English Commissioner, found that a cow was

kept to each acre of land. Dairy-farming in Friesland is at a lower ebb than formerly, and much of the depression which has existed is attributed to the closing of the English ports against Dutch cattle, which has materially depreciated their value. The fact that dairying in Denmark and Sweden has been so much improved and extended is also an explanation, as those countries have greatly influenced the Friesland butter trade. The authorities have recognised this, and the result of their investigation is that the *Swartz* deep-setting system is being largely adopted. An example of Friesland farming was shown to Mr. Jenkins, the farm being one of 125 acres, all grass, on which 36 cows are kept, besides young stock. Calves are bought in and reared for the dairy on *buttermilk and whey;* and the owner stated that his cows had averaged 850 gallons of milk for the year, which is a remarkably good yield—indeed it is more than good, it is no less than an average of 11 quarts a day for 10 milking months. The butter is made from cream taken at 12 and 24 hours. Skim-milk cheese, flavoured with cummin seed, is also made, and realises about 4*d.* a pound. This farmer breeds and rears nothing but the best cows, consequently he has a good sale for his stock, many of which go to America, at prices which for Holland are decidedly high. In South-West Friesland skim-milk cheese is not so largely made as formerly, whereas butter-making is advancing, the demand being at all times greater, and prices steadier and more remunerative. In another district ewes are kept as well as cows, their milk being made into butter for the house. Here a cow is estimated to yield about 440 lbs. of cheese per annum.

In the district where Kampen butter is made, farmers of from 50 to 100 acres keep as many as 20 to 30 cows, their milk being used for making the strong butter which butterine manufacturers purchase. Here the cows get 6 to 7 lbs. of oil-cake daily, in winter, in addition to hay. The land is well manured; straw is very scarce indeed, and the litter is often used over a second time, as

in the London hay district. Near the frontier of Zeeland rape-cake and maize are also used. Here the butter is made from milk and cream soured and churned for above an hour at 63°, a course which cannot be recommended.

On the farms of the Benevolent Society in Drenthe nearly 200 cows are kept. The calves are well fatted for veal, many being bought in for the purpose, each cow rearing 2 or 3 a year, the ration being from 1 to 4½ gallons of milk a day. At 3 months the calves go to market, selling at 4½*d.* the pound, and reaching at least 224 lbs.

Near Bodegraven, South Holland, 100 cows, 100 sheep, and 20 pigs are kept per 250 acres, the grass being particularly good, and much cheese is consequently made. If a cow can live all the year upon 2½ acres of grass, the land is considered very good indeed. In Friesland, grass is mown a second time if necessary, and soiling is often practised and found profitable. In South-West Friesland, 100 acres carry 52 head of beasts, 24 sheep, and 8 pigs.

In making Delft butter the cows are milked twice a day, and the milk is poured into copper vessels, and cooled by standing in very cold water for about 2 hours, when it is transferred to shallow pans in a very cool dairy. The first creaming is at the end of 12 hours, and the second and third at 18 and 24 hours. The cream is churned in an old-fashioned churn, which would be the laughing-stock of every competitor in a British churning competition, and does not become butter under an hour. In some places dogs are used for churning, on the turnspit principle. We have not seen this system applied in England, although churns are made for dog and sheep-power. The butter is washed, kneaded, and pickled; the next day it is packed, and it is sent to market once a week, realising about 1*s.* 6*d.* a pound. The skim-milk is sent to the chief towns in 18-gallon casks, which realise 2*s.* 6*d.* each, except in some instances, when it is made into cheese. Friesland butter is made in a similar manner to the Delft, but less carefully,

and the cream is too sour to retain its delicate flavour. When the efforts of some of the foremost men in the district have succeeded in establishing a better system, Friesland butter will probably rival the Delft. Whey butter is made on cheese-farms, but only for home consumption. Dutch dairy utensils are generally of painted wood, but why the paint is necessary, or even tolerated, it is impossible to say.

In the Hoorn district some farmers have amalgamated for the manufacture of butter and cheese, buying what milk they require for the purpose at $5\frac{1}{2}d.$ the gallon. In making skim-milk cheese to resemble the real *Edam*, the milk is curdled at 80° Fahrenheit, instead of 90° Fahrenheit, as in the latter case, and the cheese reaches 60*s.* per cwt. in price, or nearly as much as the best article. These farmers appear to have purchased the best appliances, and deserve the success they evidently enjoy.

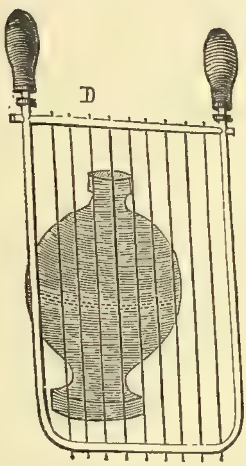


Fig. 161. Dutch "Lyre" Cheese-Knife.

Edam Cheese.

The two most popular cheeses in Holland, indeed they are almost as popular in England, are the *Edam* and the *Gouda*, which influence a large proportion of the Dutch dairy industry. The *Edam*, known as "round Dutch," is a red-coated cheese, and is made as follows: As soon as the cows are milked the rennet is added, the temperature required being 90° Fahrenheit. Coagulation takes place in 15 minutes, when the curd is cut with a lyre-like knife (Fig. 161) similar to that used in the *Gouda* system. Next the whey is baled out, the curd pressed in the tub, and finally the last of the whey removed by tipping the tub and pouring it through a sieve which retains the particles of curd.

Instead of using a curd-mill, the curd is worked with the hand, after which it is put into a round mould divided in halves (Fig. 162), a hole in the bottom allowing the whey to escape. It is then pressed, put into a cloth cover, placed in a smaller mould, and pressed for 24 hours. The cloth is then taken off and the

Fig. 162. Edam Cheese-Mould.

cheese placed in a semi-globular cup (Fig. 162), in which it is turned every day, some salt being placed on the top. After 8 days it is washed, dried, and placed on the shelf in the cheese-room, where it is turned in the usual manner for several weeks, and rubbed with linseed oil. In one of the North Holland

Fig. 163. Mould used in salting the Edam Cheese.

factories it is the practice to add the rennet at a temperature of 84° Fahrenheit, and the milk is allowed to stand for an hour; the curd is then thoroughly cut, cooked to 94° Fahrenheit, and further treated as described above. It requires 1 gallon of milk to make 1 lb. of cheese, the annual yield of cheese per cow being 450 lbs. *Edams* weigh about 5 lbs., and sell at prices varying from 50*s*. to 60*s*. per cwt.

The following is another description of the Dutch process from the German of Benno Martiny.

The newly-drawn milk is placed in a wooden vat, at a temperature of 90° to 93° in summer, and 93° to 97° Fahrenheit in winter. One part of rennet is added to 1000 parts of milk, and thoroughly mixed with it, and the vat is then covered. The quantity of rennet is slightly increased as the milk gets older since calving, or as it gets richer or decreases in temperature. If part of the milk is skimmed, then a much smaller quantity will suffice. The correct quantity is to be ascertained by the fact that the curd must set in 8 to 15 minutes, therefore the liquid must be as concentrated as possible. With the rennet the colouring is added, this being done in reversed proportion to the fat percentage of the milk. To 1 oz. of rennet 2 teaspoonfuls of annatto are required, the two articles being well mixed together before they are added. After coagulation the curd is carefully broken up in all directions for 5 minutes. When the temperature of the surrounding air is low, about 59° Fahrenheit, the vat is covered for 2 or 3 minutes, and when the cut curd settles at the bottom of the vat, the maker tries carefully to unite the mass in one lump by means of a wooden basin, which operation occupies about 6 minutes. The whey is then removed and passed through a sieve. Next the curd is put into a mould and a weight of 35 lbs. placed upon it; after 4 or 5 minutes the whey so pressed out is removed, and the pressure renewed three times for 5, 4, and 3 minutes respectively. At this point of the manufacture the curd should show, in winter 82° Fahrenheit, and in summer 90° Fahrenheit, otherwise it must be brought to this temperature by means of hot whey or cold water. Next the curd is removed into a perforated mould and pressed for 4 or 5 minutes, being turned three or four times.

It is the practice of some makers in North Holland to put a teaspoonful of salt in the centre of the cheese, but in warmer climates, in order to prevent fermentation, it is better to knead a

solution of salt into the cheese. The latter mode is also advisable in times of electric disturbance in the air. The removal into the moulds must be executed as quickly as possible, so that the curd does not cool, and for this reason the manufacture of quantities of 30 gallons of milk is conducted by two persons. When the cheese has been sufficiently pressed with the hands, it is placed into a bath of fresh whey, in summer, at 126° Fahrenheit, in winter 131° Fahrenheit. It is taken out after 1 or 2 minutes, and pressed again in its mould for 2 minutes, and lastly it is enveloped with great care in linen, in order to remove the remainder of the whey. Thus enveloped the cheese is put back into the mould and pressed, the time of pressing varying according to the season: in March and April from 6 to 7 hours, November and December from 1 to 2 hours, the other months 12 hours. After pressing, the cloth is removed and the cheese is placed in a mould for salting; these moulds standing in cases which allow the remainder of the whey to drain off. On the first day only a little salt is laid on the top of the cheese; on the next and following days, on the contrary, the cheeses are each time placed upside down, in a mould containing wet salt, and it is necessary that a salt-crust of considerable thickness should adhere to the surface. The salting is continued until the salt has penetrated into the interior of the cheese, which will be the case when it has become hard, instead of soft and elastic; this generally takes from 9 to 10 days. Finally, the cheeses are laid for a few hours in brine, they are then washed, dried, and placed on shelves in the warehouse, arranged according to age. The manufacture proper is there ended. The warehouse must be dry, light, and well aired, and never above 72° Fahrenheit, or below 45° Fahrenheit. The opening of the windows during dry winds, damp air, and fog should be carefully avoided; in the latter case an injurious yellow-red mould will cover the cheese. During the first month in the warehouse, the cheeses must be daily turned once; during the second month only every other day, and later on only twice weekly; in times of electric disturbance in the air all cheeses

should be turned daily. At the age of 24 to 30 days the cheese must be softened for an hour in water of 72° Fahrenheit. It is then washed with a brush and allowed to dry in the sun, after which it is replaced on the shelf. Two weeks later this treatment is repeated, and the cheeses are also rubbed with linseed oil, after which they are left on the shelves until delivery. Before this takes place, however, they are scraped, levelled, and polished with a very sharp knife, and painted according to their place of destination. Those which are sent to England or Spain are coloured yellow, by means of linseed oil mixed with a little annatto, while the others are twice covered with the following mixture of paint :—Tournesol (croton tinctorium), 12 lbs.; Berlin red, 13 ozs.; water, 20 lbs., for 1000 cheeses. When this coat has dried, the cheeses are rubbed with a little butter, coloured with some Berlin red. They are packed in cases divided into compartments, holding one cheese each. Good cheese of this kind is covered with a light, blue-greenish, very dry substance; while inferior cheese turns fatty, damp, and hollow. Cheeses destined to travel are pressed for 12 hours.

The principal cheese markets in North Holland are Alkmaar, Hoorn, Purmerend, Medemblik, and Edam, and the annual export from this province amounts to 20,000 tons. The cheeses made in the neighbourhood of Hoorn are considered to be the best, and it was this district that we chose in which to see the process of *Edam* cheese-making, when in Holland for the purpose.

The curd-knife used is an implement about 10 inches wide by 20 inches long; at one end the two corners are rounded, at the other are two handles, and there are nine metal knives or bars running from end to end. The presses are very primitive and elaborately turned and painted, but the pressure required not being so great as for our large British cheeses, they answer very well. The moulds in which the cheeses are placed are made so that the whey can drain from the bottom, and the covers, which are circular inside, or cup-shaped, fit nicely over the head of the

cheeses upon which they rest, and which are easily pressed, because their diameter is a shade less than the inside of the mould. In pressing, four moulds are generally placed within a square tray and stood upon the press, two bars of wood are then placed over the flat-headed lids, across which the foot of the press rests at right angles.

Among the *Edam* cheese-farms which we have visited in North Holland were those of Messrs. Sluis, of Beemster; George Nobel and K. Nobel, of Bobeldyk, Berkhout, by Hoorn; Slachter, Wall, and De Yong; and the following items which we noted in the manufacture of their cheeses may be compared with the descriptions already given.

In one case, that of Mr. Wall, the evening's milk was skimmed and added to that of the morning. In this way he is able to make 20 lbs. of butter for every 100 cheeses.

Mr. George Nobel's milk was set to curd upon our arrival at 5 a.m., and his wife commenced to cut the curd with the harp-like knife in 15 minutes after setting, although the curd did not break perfectly over the finger as we like to see it in England. Its temperature, too, was only 85° Fahrenheit. In this case, three-quarters of an ordinary teacupful of home-made rennet was added to 10 gallons of milk. After continually cutting the curd backwards and forwards for 10 minutes, the whey was separated, and then the work was conducted much faster, the curd being splashed like water. The whey was baled from the vat with a round wooden bowl in half-an-hour after setting. Here 17 cows were kept upon 58 acres.

At Mr. K. Nobel's, one-day cheeses, which were tolerably firm, were floating in the brine-trough, and they remained there 3 days. The curd was pressed in the moulds with the hands, turned, and again pressed and squeezed again and again, as we have already described. In half-an-hour the now formed cheese was taken out of the mould and folded up in a clean cloth, the ends being neatly gathered up and pinned over. It was then

again put into the mould, and the top portion of the cloth pinned as before, when the cap was put on, and the cheeses taken to press, where they remain about 4 hours. The milk was set at 90° Fahrenheit, and the curd cut in half-an-hour. On this farm cream is churned at 60° Fahrenheit, and butter makes *2s. 2d.* per kilogramme. Five cheeses were made twice daily, and this number was moulded in our presence by mother, daughter, and servant, who worked together. The maid-servant was paid £11 a year wages, and the land was rented at £4 an acre. Visser's rennet was used to the extent of 20 cubic centimetres to every 5 cheeses, but home-made rennet is sometimes used, and then 40 cubic centimetres are required for the same work. Mr. Nobel prepares rennet from 25 skins every three months. The cows are frequently purchased in the market, and cost about £20 each. At this farm also, Mr. Nobel's daughter and servant displayed the manner of dressing their heads in the peculiar gold and silver skull-caps, pins, and lace common to the district.

At Mr. Slachter's farm were some milking ewes whose milk was given to the calves to the extent of a pint daily. The system on this farm was the same as above mentioned.

Mr. Sluis is a farmer of very different calibre. His entire business is conducted upon modern principles, and the entire *tout ensemble* is as different from that of his neighbours as it is possible to imagine. The whole of the daily work is chalked upon a black-board, so that he can see exactly what is done at a glance. On the day of our visit the morning's milk was 177 kilogrammes, that of the evening 198 kilogrammes, and this, with milk received from his son, made a total for the day of 449 kilogrammes. In dealing with it, it appeared by the board, which showed the apartment to be 17° Centigrade, that the milk had been set at 30° Centigrade (or 86° Fahrenheit), and that 14 grammes of annatto and 114 grammes of rennet had been used. The cheese made from the milk, which was already in the press, weighed 50 kilogrammes when put in, and 46 kilogrammes when first

taken out. It also appeared from the board that the night's milk, 198 kilogrammes, had been skimmed in the morning, and had yielded 18 kilogrammes of cream, which had been added to the whole bulk of milk, 449 kilogrammes, when it had been mixed together.

Gouda Cheese.

The *Gouda*, or flat Dutch cheese, if not so popular as the *Edam*, is nevertheless a most valuable food, and forms a very important item in the economy of the working classes. There are two kinds of *Gouda* cheese; one being comparatively small in diameter and rounded at the edge, and known as *Gouda*, and the other, which is larger in diameter and flat at the periphery, and called *Derbyshire*. Both kinds are manufactured in the following manner:

Fig. 164. Gouda Cheese-Mould.

Morning and evening the cows are milked, and cheese is made as soon as possible after each milking, usually by the farmer's wife or daughter. If the milk, after being put into a large wooden tub, is not warm enough for the rennet to be added, some hot water is mixed with it, until the temperature is raised to 93° Fahrenheit. After 25 minutes the curd will be fit to cut, if it is intended to make *Gouda*, or, if *Derbyshire* is to be made, 17 minutes will suffice. The cutting of the curd is performed with the native harp-like knife described previously, and also, in some cases, with a sharp English or American gang-knife. The curd is neither cooked nor salted, but put into moulds (Fig. 164) and pressed for 24 hours. The cheeses are afterwards put into a salt bath, strong enough to float an egg; the strength of the brine being maintained by continual additions of salt each time that fresh cheeses are placed into it. *Derbyshire* cheese is kept in brine for 4 days and *Gouda* 7 days. After

being taken out of the brine, the cheese is washed, dried, and shelved, much in the same manner as in English dairies.

In the Gouda district the dairy is generally a separate building from the farmhouse, but the cheese, having been made, is pickled and partly cured in cellars more or less beneath the ground. The bulk of the cheese is made in the summer, and as during that time of the year the cattle are night and day on the pastures, the cow-stalls are generally used for the storing of cheese.

The following is another method much practised. The new milk is placed in a vat holding about 30 gallons, and the curd is cut in 15 minutes. It is then well stirred in all directions with a wooden stick three or four times, when it is left to stand for a few minutes. It is next again slowly but constantly stirred and broken up. When the curd and whey have separated, the latter is completely removed. Next, hot water is poured on the curd; hotter if the cheese is destined to travel, and less hot if it is to be consumed on the spot. In a quarter of an hour the water is removed, the curd being first pressed together, and then again thoroughly worked and broken up. It is next cut into very small pieces and squeezed, and then placed into round wooden perforated moulds. The curd is then taken out again, well squeezed with the hands, pressed in the cheese-vat, and placed again in the mould. It is then pressed for 24 hours, taken to a cool cellar for a second 24 hours, and placed in a bath of brine; then taken out, rubbed with salt on one side, and, after 12 hours, also salted on the other. A cheese of 15 lbs. remains 4 days in salt, or, in warm weather, longer. After salting, the cheeses are washed with hot water, and placed on the shelves in the cheese-room, being daily turned. If any cheeses get dirty they are washed again with hot water, and dried with a rough linen cloth. After 4 weeks a *Gouda* will be fit to be eaten, or, if strongly salted, a little later. When the cheese is 3 months old it need only be turned once a week. Many cheese-makers rub the 14 days old

cheese with beer and vinegar, or with vinegar in which saffron has been dissolved, by which means it not only obtains a beautiful yellow colour, but is also protected against flies. *Gouda* cheese contains 36·1 water, 29·4 casein, 27·5 fat, and 0·9 salt.

There is little to learn in Dutch cheese-making, for the systems are much inferior to those adopted in England. It is true that the people work hard, and save time, for they even add their rennet to the milk directly it is taken from the cows, and is being rowed in their boat from the pasture to the homestead. We thought, too, that they were not sufficiently clean in their habits, nor do we believe that high-class cheese is made in many cases by these small farmers. With Mr. Jenkins, the Secretary of the Royal Agricultural Society of England, we visited the immense warehouse of Messrs. Heineken & Son, of Amsterdam, whose display of thousands upon thousands of various Netherlands cheeses was very imposing. We requested Mr. Heneiken to select us one of his best of each of the varieties of *Edam* and *Gouda*, and we confess that, although unimpressed with the cheeses of his country, the *Gouda* cheese in particular was of the highest possible merit, and favourably compared with anything produced in England, if *Stilton* is excepted.

At the International Agricultural Exhibition at Amsterdam, in 1884, we were kindly shown over the magnificent display of cheeses and butters exhibited by Messrs. Wijman & Son, in the palatial edifice which they had erected upon the grounds. Here, girls in the costume of the country were selling samples of butter and cheese, the latter being displayed by thousands on each side, of every colour and state of ripeness. Mr. Wijman explained that the butters of Holland were those of Kampen, Zwolle, Delft, Leiden, Friesland, and Meppel, and we were enabled to taste samples of each; but, with the exception of the Kampen specimen, which was extremely mild, there was not one which an Englishman, accustomed to eat respectable butter, would touch;

and this fact prepared us for what we saw in the famous province of Friesland, and more particularly in the neighbourhood of Kampen and Zwolle.

Through the kindness of Mr. Van Hasselt, of Kampen, we were enabled to see the system adopted by the butter-making farmers of this district. Mr. Van Hasselt himself conducts his dairy upon the *Swartz* system, and has built an ice-house for the purpose, which is of wood, double-walled, and lined with peat. He finds the *Swartz* system a great success, and is endeavouring to persuade his neighbours to substitute it for the ordinary system of the country. The ordinary farms are all small, and the homesteads cover the cows, horses, implements, and, in fact, everything, the common living apartment being the end of the cow-shed, in the centre of which is the horse-gear for working the churn. The milk is set in small wooden vessels, painted inside, which resemble the lid of a flour-barrel. These are piled one on the top of the other in the milk-room, which is partly below ground, but in hot weather they are first cooled by standing in the passage, between the outside door and the cow-shed, in which a strong draught is encouraged. The churns used resemble the *Holstein*, but are much more primitive. As a rule it takes 16 litres of milk to make 1 lb. of butter, which is what may be expected from Dutch cows, for the milk in Holland, according to its English reputation, is found to be extremely poor, in spite of the assertions of the farmers themselves, who, ignorant of the richer quality of English milk, rate their own higher than they would otherwise do.

We have little to learn from Holland in a butter-making sense, for the farmers in general are poor and ignorant, and have really no system but the primitive one of their forefathers. They make the worst of butter, and cannot pretend to compete with either France or Denmark in the supply of a high-class article. We have, however, very much to learn from them with regard to their industry, which enables them to do so very much with a small quantity of land.

CHAPTER XXIII.

DENMARK.

SINCE the visits of Mr. H. M. Jenkins to Denmark, in his capacity as Assistant Commissioner of Agriculture, and the later investigations of M. Eugène Chesnel, Secrétaire de l'Institut Agronomique, and the publication of the works of these gentlemen, the eyes of the dairy world have been cast upon Denmark with something akin to wonder; for, by means which are not difficult to understand, she has so changed her system in the space of a few years, that, at the present moment, she is almost purely and simply a nation of dairy-farmers. Not only has Denmark taken an extraordinary position in the butter market of the world, but she has, in connection with her dairy-farming system, been enabled to ship to England such quantities of cattle as frequently outnumber the imports from any other country. And yet Denmark is a small country, for, since the loss of Schleswig, it only comprises Seeland, Funen, Laaland, Falster, and other islands, with Jutland, the northern half of a peninsula projecting from Germany, and reached by travelling through Holstein and Schleswig. This is by far the largest portion of the country, being nearly 10,000 square miles out of 15,000, while the entire population is about 2,000,000. There are no rivers of importance, no mountains, and little coal; while, owing to the fact that very little wheat is grown, black bread is the common food of the people. The acreage is just under 9½ millions, but of this only

about 7 millions are cultivated. There appear to be about 2,000 large farms, a little over 70,000 of medium size, and 165,000 small farms. Upon these holdings the live stock may be estimated at 1,500,000 cattle, 2,000,000 sheep, and nearly 750,000 pigs. In 1877–78 Denmark exported 73,336 head of cattle; but during the first five months of the year 1883 she sent to England alone 53,000, which will give some idea of the magnitude of her prosperity. But this is not all. We quote cattle and butter side by side, because the one is produced in conjunction with the other. In 1865 she exported to England about 7,000,000 lbs. of butter. In 1875 this was raised to 23,000,000 lbs., while in 1882 it had reached 34,000,000 lbs. According to the *Grocer*, in the first fortnight of January the best Danish butter made 135*s.* to 170*s.*, and in February 135*s.* to 160*s.*, and March 158*s.* to 168*s.*, whereas the top quotations of Irish butter appear to have been 157*s.*, and of Dutch 150*s.*

This extraordinary prosperity is the result of two influences—the agricultural societies, and organised instruction in dairy-farming. When in Denmark, Professor Segelcke, who occupies the highest position in the country upon this question, very kindly explained to us the system of instruction as it is conducted under his guidance. His own course of scientific teaching comprehends forty lectures, although he almost invariably gives many more. He has devoted himself, however, in the past, to the organisation of a scheme for practical instruction, which, at the time we first had the pleasure of meeting him, had already resulted in his passing 900 young people into different farms for the practical study of dairy-work. Upon application to the Professor, the student is, in due course, sent to a particular farm, where arrangements have been made to receive him. Most of the farmers who receive pupils of this kind require them to work, although, as the duration of their stay is usually about two months, they do not often become of the highest value before leaving. Some farmers take two pupils at a time—their year

commencing on the 1st of November and ending on the 31st of August—so that ten are passed through within that period.

Professor Segelcke's great object has been to place Denmark at the head of all dairy countries, and he has to a great extent succeeded in the department of butter, although, up to the present, Denmark has not taken a high position with cheese; for there is no special cheese made, of high merit, which is peculiar to the country. At the National Exhibition of 1883, which we attended, great efforts were made, by providing high prizes for cheese, to obtain first-class samples; but, as might be expected where butter-making is the principal object of the farmer, there were few but skim, or separated milk cheeses, exhibited, most of which, admirable as they were, were not of such a nature as to found a reputation for cheese-making. It is, however, of the highest importance to ascertain what method to adopt in producing skim-milk cheeses of the highest class, and this, in time, the Danes will clearly do.

An idea of the size of the farms, and of the type of men who exhibit—and they are very numerous in Denmark—is afforded by the class for sweet-milk cheese at the exhibition to which we have referred, for with every entry the farmer gave particulars of the number of cows kept; thus taking half-a-dozen names of exhibitors at random, we find that they keep 33, 180, 30, 40, 130, and 200 cows respectively. In the class for cheeses made from separated milk, however, the first six names were of farmers who kept 80, 100, 300, 210, 510, and 450 cows respectively, every farm thus being of considerable magnitude.

When the student gets into harness he goes to work as though he were an engaged hand, commencing duty at 5 a.m., and on some farms at 4.30 in the morning, noting in his pocket-book, which is provided for the purpose, the various items of the day's work as they occur, so that at the close of the day he can, as it were, post them into his larger and permanent record. The day's work is generally as follows, varying of course in different dairies:

The first thing in the morning the cows are milked, and the milk aërated, weighed, and separated if a separator is used, if not, it is put into the *Swartz* cans. The cream of the previous day is next churned, the butter worked, salted, and weighed. If skim cheese is made, the milk for this is heated and set, when breakfast is taken, the food being plain. After this the cheese is made, the operation continuing until the curd is under the press. The new cream is then prepared for the next day's churning by adding a little sour cream or buttermilk according to custom, and the newly-made butter is afterwards packed in the kegs ready for sending away, when washing-up commences. We were in one dairy at 9.30 a.m., and this cleaning was in progress, but here the early finish of butter-making was remarkable, although the hour of commencing was 4.30. After dinner, unless cheese-making is considerable, matters are taken easily until the evening's milk arrives, and is run through the separator or placed in the newly prepared *Swartz* cans, standing in freshly-iced vats. In noting the various processes, M. Chesnel—who himself passed some weeks as a student at one of the farms—gives the following particulars of items which have usually to be placed upon record: Every day's weight of milk and temperature of dairy; quantity of milk employed in butter or cheese-making; cream raised and churned; weight of butter obtained and packed; cheese made per pound of milk; quantity of rennet, colouring, and salt used. It is by means of a system of this kind that the butter-maker can continue to make an article which has no variation in quality, an important matter indeed where uniformity is so very necessary.

The following quotation from Mr. Jenkins' report upon technical instruction bears distinctly upon the method of education adopted in Denmark. Mr. Jenkins says: "It is necessary to chronicle the fact that almost every large dairy-farm of good repute in Denmark, is a practical school of dairying for farmers' daughters. These young women remain on the farm for one or two years, and do all but the heaviest work of the dairy, in exchange for instruc-

tion, board, and lodging, and sometimes a small payment, generally £2 to £3 per annum. As a rule there are not more than three or four pupils in the dairy at one time; but an exceptional case is that of Mrs. Hannah Nielson, who, on a farm of 170 acres, generally has about a dozen farmers' daughters as working pupils, who are boarded and lodged in the farm-house, remaining for various periods extending from six weeks to two years. The pupils who remain only a short time pay for their instruction a considerable amount relatively, but they all work as hard as an ordinary dairymaid could be expected to. Their usual length of stay is six months, and vacancies in their ranks are always immediately filled up. I inquired the position of the parents of these girls, and learnt that most of them were peasant-farmers keeping from 10 to 15 cows, but some have larger farms. One girl was indicated to me whose father kept 40 cows; she was about to be married, and her parents thought her fortunate in being able to learn under Mrs. Nielson how the dairy of her future home could be turned to the most profitable account.

Each pupil has 5 cows allotted to her in rotation, and the results of the several milkings are carefully noted, the produce of each cow being entered separately, morning and evening, together with the name of the milker. Mrs. Nielson thus has a practical means of knowing whether her pupils can perform satisfactorily, one of the most important, as it is one of the most fundamental and most neglected, operations connected with dairy-farming. The knowledge that the results of their milking are "booked," also produces a spirit of emulation amongst the girls, which gives far better results than any system of supervision. It should be added that on some farms where the head of the dairy is a man, the pupils are also men.

The results of agricultural education in Denmark have been something extraordinary, and, to enable the reader to appreciate them accurately, it would be necessary to give a history of the agriculture and the trade of the country for the last quarter of a

century. Let one fact suffice. In 1860 the British Vice-Consul at Copenhagen reported that "the butter, or the article sold in the market by the yeoman-farmers under that name, is execrably bad." At present, Danish butter in its season has practically no rival in the London market. This result is directly traceable to technical instruction. The same tale is told both by the amount and the quality of other articles exported, especially of barley and pigs, and quite recently of cattle.

We have referred above to Mrs. Hannah Nielson, whose dairy was visited by Mr. Jenkins, and subsequently by ourselves. Mr. Jenkins has described her system at some length in his Report upon Denmark, to which we have much pleasure in referring; but we cannot omit to notice a system which might be imitated with advantage in this country. Mr. Nielson is a well-to-do farmer residing some twenty miles from Copenhagen, and his farm and buildings are unusually good. He keeps a number of Danish cattle and sells the milk to his wife, who, with the assistance of her dairy-maids (and at the time of our visit, they were ten in number, and strong, hard-working daughters of small farmers), provides sufficient butter and cheese for sale in her shop in Copenhagen, which she manages in person. Mrs. Nielson has visited several European countries, and although ignorant of the languages, she has learned to make a number of the highest classes of cheese, which she sells to her customers. In this way she obtains a maximum profit, and is never troubled with a drug of one particular article, for, by means of the variety she produces, she is always able to sell. The milk-room at Havartigaard, Mr. Nielson's farm, is similar to that adopted throughout Denmark where separators are not used. This apartment is kept under lock and key, and is four steps below the floor of the cheese-room, the temperature upon a very hot midsummer day being 60° Fahrenheit. The milk was set upon the *Swartz* system in five tanks, two of which were double. These were 6 feet in length, by 21 inches in breadth and 2 feet in depth. All were made of concrete and filled with water

and ice. The cans used were 2 feet high by 9 inches in diameter, four being used in each small tank. The ends of the tanks are fixed to the wall, and above them is a concrete trough along which the cold water runs, passing into the tanks by means of small pipes. The overflow water is let out at the opposite end, and, as a running stream is kept up, this, aided by the ice, keeps the milk sufficiently cool even in the hottest season.

We learned that the value of Danish dairy cows, such as Mr. Nielson's, was 200 kroner or about £11 each, whereas the average yield of milk was 8½ quarts per diem. It does not cost Danish farmers much for labour, as upon this farm the men received £4 half-yearly in addition to their board, whereas the girls, who are really pupils, paid about £11 per annum, in addition to the services they rendered.

M. Chesnel found that the chief requirements of the Danish farmer, were a stone-paved cheese-room; a milk-room, built from 2 feet to 2 feet 3 inches below the surface of the soil; and a churning-room situated at the side of the dairy, all of which must be well ventilated and arranged so that the cleaning can be conducted to perfection.

Generally speaking the cows are milked twice daily at from 4 to 5 o'clock, both morning and evening. The pails used for the purpose are brightly painted, and are smaller at the top than at the bottom. One man is usually allotted 20 cows. It is customary to test the milking properties of each cow once a month, by weighing the milk morning and evening. When cream is sold it is divided into two qualities, the first yielding 1*s.* 3*d.* and the second 9½*d.* the quart. New milk costs about 2½*d.*, and milk which has been once creamed 1*d.* a quart.

There are two classes of butter made in Denmark, one of which is called Södtsmör, or sweet butter, and Surtsmör, or sapid butter. M. Chesnel, who has fully investigated this matter, says that these Danish words have produced some confusion in France, the one having been translated as "sweet," and the

other as "sour," and it has been asked why the Danes, after employing the *Swartz* system in order to obtain sweet cream, afterwards make it artificially sour. As a matter of fact the French make little "sweet" butter, unless it be from the first cream or *fleurette*, and this they do very seldom. Danish sweet butter is made from cream immediately after skimming, whereas the ordinary butter of the country, which is more developed in flavour, is made from cream which has ripened or soured for 24 hours. In a number of analyses of Danish butters made by Professor Storch, it was found that in sweet butter the water ranged from 12·12 to 14·11 per cent., the fat from 82·33 to 85·52, the casein from ·57 to ·64, the sugar from ·39 to ·52, and the salt from ·90 to 1·83; whereas in the "ripened" cream butter the water was 17 per cent., the fat 80, the casein ·75 to ·99, the sugar ·13, and the salt ·94 to 1·40. Professor Storch also showed that (1) sweet butter contains ·02 per cent. of free lactic acid, and sour cream butter ·1 per cent.; (2) the quantity of casein and lactic acid which the butter contains is augmented with a proportion of water; (3) the elements of milk which remain in the butter are presented exactly as in the milk which is churned; (4) in sweet butter the microscope shows a large number of small fatty globules which are equal in size, whereas in the "Surtsmör," these globules are larger and unequal in size; (5) the microscopic drops of skim-milk which are contained in the pores constitute the physical properties of butter (the chemical properties of this same milk occasion the taste and the perfume of the butter); (6) sweet butter contains in its pores the skim-milk in its fresh state, *i.e.*, that the casein is completely dissolved, and that the quantity of milk-sugar has not yet varied. In the soured butter the pores are full of sour skim-milk, it contains a larger proportion of casein in suspension, and a smaller proportion of casein in solution; the quantity of milk-sugar has much diminished because a portion of it has been transformed into lactic acid; and (7) the reason of the greater or less capacity of butter to keep in a preserved state is in the quantity and the

nature of the humidity which its pores enclose. M. Chesnel pertinently remarks that this is an important fact, as it explains why, in the manufacture of sweet butter, the dairymen prohibit their workpeople from putting the butter into contact with water, preferring to wash it in skim-milk. This custom is rigorously observed, more especially by those who manufacture for exportation. It would appear from this that the washing with water, which both French and British makers consider so important, is not believed by the Danes to be essential to the proper preservation of butter.

In the manufacture of butter in Denmark, soured cream is principally used; thus the milk, where a separator is worked, is passed through the machine, and afterwards set to ripen until the following day. Whether that ripened or acid state is natural or artificial, a fermentation is set up which is considered necessary, not only for the development of the flavour, but to obtain a larger percentage of butter. There are various ways of artificially souring the cream, and among them are the following: After skimming, the cream is warmed to from $62\frac{1}{2}°$ to $64\frac{1}{2}°$ Fahrenheit by plunging the metal cream vase in a pan of hot water. The cream is afterwards left for 24 hours, but maintained at $62\frac{1}{2}°$ Fahrenheit. Another way is to heat the milk from $53\frac{1}{2}°$ to $55\frac{1}{2}°$ Fahrenheit, and afterwards add 2 per cent. of churned milk, when it is allowed to stand until the following day. A third system is to heat the milk to 52° Fahrenheit, when a small quantity of acid cream is added. The best result is obtained by the first system, which is very common in the country. In churning, the machine known as the *Holstein* churn is generally employed, although other makes are gradually finding buyers throughout Denmark. When the butter has come, it is taken out of the churn with a small sieve, and placed in a kneading-trough, which has been previously washed with warm water, rinsed with cold, and afterwards cooled with ice. When ready for working, the butter is removed to the trough, a somewhat cumbrous wooden stand, which is

quite free from angles. There is a small hole at the bottom of the trough, in order that the drainage from the butter can be carried away into a sieve, which is placed beneath. In commencing to work the butter, a lump weighing from 12 ozs. to 18 ozs. is first taken, and thoroughly kneaded with the hand on the edge of the trough. This working proceeds, with similarly sized pieces, until the whole of the butter has passed the trough, each piece being worked several times over, and lastly formed into rolls by roughly rolling up the thin layer of butter. It is then weighed,

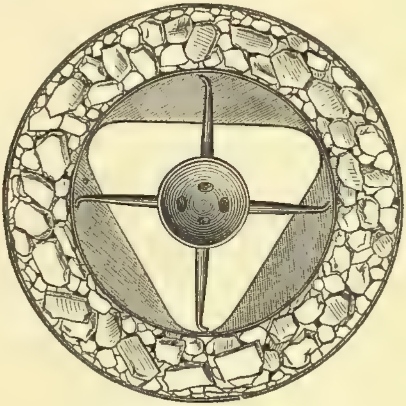


Fig. 165. Danish Cream-Cooler.

and an account of the weight is noted. The butter is then again taken, piece by piece, to the trough, and spread out in a thin layer, when it is powdered with fine salt to the extent of 1¼ ozs. per kilogramme (2¼ lbs.). The salt is then rapidly worked into the butter, and a fresh piece of similar size is spread over it, pressed upon it with the hands, and salted, when the mass is again formed into a roll as in the first working, although with more care. When the whole of the butter is thus salted, the rolls are placed upon a butter-board, and carried to one of the empty milk-vats, and left for three hours in ice. There it becomes firm, and is more completely penetrated by the salt as it dissolves.

Finally, it is again taken to the trough and vigorously worked until it becomes of a proper consistence. It is then put into barrels of beech-wood, which hold 14, 28, and 36 kilogrammes respectively. Here it is pressed with the hand as it is put in, in order that there may be no interstices in any portion of the mass

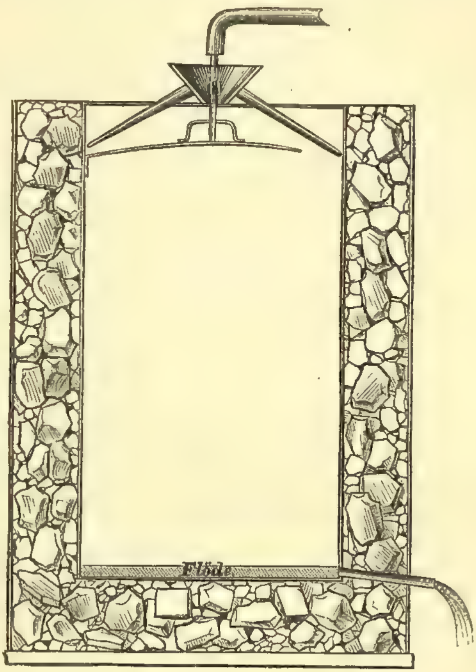


Fig. 166. Danish Cream-Cooler.

into which air can penetrate. When full, the surface is covered with a clean cloth and it is at once closed down. Before a barrel is used the entire interior is well rubbed with fine salt. During the whole time that the butter-maker is conducting his work he continually bathes his hands in warm water, and immediately after in cold in which ice is floating.

The illustrations represent a cream-cooler as used in Denmark,

and manufactured by Messrs. H. C. Petersen & Co., of Copenhagen. A white metal drum is placed within a larger drum, the cavity or lining between being filled with water and pieces of ice. In Fig. 166 the cream is shown flowing from the tube into a funnel which revolves upon a point, and is provided with four holes which open into four tubes. As the cream falls into it, it gives the funnel a rotary motion, so that the cream is carried through the four tubes, and, slowly descending, is spread over the large cooling surface formed by the wall of the inner drum, leaving the cooler through the tube at the bottom and having attained a suitably low temperature.

There is much to learn in Denmark, and the British dairy-farmer, desiring to see a good system of managing dairy cattle, of manipulating milk, or of making butter, could not do better than visit some of the many large farms which may be found throughout the country, very many of which may be almost described as factories.

During our visit to Denmark we had the advantage of inspecting the farm of Mr. Harold Branth, of Elkjœr, in Jutland, which is a fine specimen of the system of agriculture of the country. It is situated in the extreme north, and by the side of the railway a few miles beyond Aalborg. This district somewhat resembles North Holland, for an important road intersects the country and is studded from town to town with numerous farmhouses, there being few cross-roads and no buildings of any kind on either side, so far as the eye could reach.

Every farm, too, whether large or small, is surrounded by a number of trees, which are grown upon at least three sides, and these vary in extent from a few acres to the size of Elkjœr, the farm in question, which is rather more than 700 Danish acres, a Danish acre being 28,000 square feet. Of that extent, 500 acres are cultivated fields; 10 occupied by buildings, domestic offices, garden, and shrubbery; 60 meadow and peat-moss; and 140 for planting young fir-trees.

The cultivated fields are divided into the high fields and the low fields. The high fields are subdivided into eight fields of 20 Danish acres each, all good sandy loam, which are cultivated as follows: First year, half fallow (manured); second, rye; third, mixed grain (say oats, barley, peas, and vetches, mixed together) or barley; fourth, roots (turnips, manured); fifth, two-eared barley; sixth, oats (manured); seventh and eighth, grass and clover.

The low fields are good deep mould, with a subsoil of marl, and comprise seven fields of 35 Danish acres, each of which are farmed in the following way: First year, six-eared barley (manured); second, mixed grain; third, roots (kohl rabi and turnips, manured); fourth, two-eared barley; fifth, oats (manured); sixth and seventh, grass and clover. The remainder of the cultivated fields are partly devoted to grain, roots, and grass, without any fixed rotation of crops.

The stock consists of 160 milch cows, which are kept up by breeding under Mr. Branth's own supervision, 70 fat beasts, 50 young cattle and bulls. About 80 calves are yearly bred, of which one-half are for the renewal of the stock of milch cows, and the other half are fed until 18 months old. The best will weigh 1100 lbs. Danish, and thus those which are 1½ years old have increased 2 lbs. daily in weight since their birth. The cows are of the pure Jutland breed (the largest of which weigh about 1100 lbs.), and they give a yearly average yield of about 5000 lbs. of milk per cow. The average quantity of fodder given to them in the sheds is 5 lbs. of heavy feeding stuff (meal, all sorts of cake and bran; in fact, every kind of fodder, except straw, hay, and roots) and 20 lbs. of turnips per cow. The period during which they are out at grass is generally from May 15 to October 1. The fat beasts are fed with 80 lbs. of turnips daily, and 4 lbs. to 5 lbs. of linseed cake; and on this food they increase 2 lbs. daily in weight. There are fed yearly 100 to 120 pigs, up to a weight of about 250 lbs.

Cheese is only made for domestic use, as the calves get the skimmed milk. The dairy is worked with a steam-engine of 4-horse

power, driving Burmeister & Wain's large centrifugal separator, two churns, one machine for crushing grain, and one cake-crusher. The centrifugal machine is worked twice daily, and the milk consumed gives during the winter months, 27 lbs. to 1 lb. of butter, and during the summer months 1 lb. less. The dairy has large, light, and airy rooms, which are kept scrupulously clean and well ventilated. The cream is soured in 24 hours, when the churning takes place at a temperature of 12° to 14° Réaumur (59° to 63° Fahrenheit). During the summer months ice is used for cooling the cream, to keep the temperature low. The skimmed milk used for domestic purposes is cooled in water or ice. The milk for the calves is boiled in a large copper, and, when cheese is made, the milk passes direct from the centrifugal machine to the cheese-tub. The stock of horses is 20 for working, and one riding horse, and two to four foals are reared yearly.

The work on the farm is done by about 20 apprentices, in addition to a foreman and 5 daily paid men. The apprentices are mostly sons of well-to-do peasant farmers in Jutland, who have had a general practical education at home; and it is more particularly the cultivation of roots and the breeding and care of cattle which they seek to learn at Elkjœr. Mr. Branth reads with them two evenings a week during the winter months, partly by giving them lessons in chemistry and physics, and partly by lectures bearing upon agricultural questions of the day. As a rule, they remain one to two years, rarely any longer.

Upon our visit to Elkjœr we had the advantage of being conducted over the farm by a very intelligent student, who, with the head dairymaid, explained the whole process of the dairy work. As a general rule, 2000 lbs. of milk are separated per day, this quantity coming, on the day of our visit, from 130 cows, which would give an average of 15 lbs. per head, or about 6 quarts English. This milk produced 75 lbs. of butter, the quantity varying as mentioned above in summer and winter, although when the cows are highly fed in winter they sometimes reach the

summer yield; but in spring and autumn it occasionally falls to 22 lbs. per 1 lb. of butter, and, although so much richer, is considerably less in quantity. The separator is worked one hour in the morning and one hour in the evening, as nearly as possible 1000 lbs. being passed through on each occasion. This brings the high average of 20 per cent. of cream, which will rather astonish those butter-makers who consider 15 per cent. good; but, although it is a thinner cream than that taken in the ordinary way from open pans, there is no doubt that it contains more fat, and consequently more butter is made than under the old system. This fact would be admitted from the figures shown above, 26 lbs. of milk to 1 lb. being equal to 10 quarts, which, as a rule, is only exceeded by the best Jerseys in this country. About 1100 lbs. of the skimmed milk is given to the calves, which are never allowed to suck the cows. From their birth the calves receive new milk for about a fortnight, after which boiled skimmed milk is used, together with linseed-cake and oatmeal, and they are allowed all they will eat of these foods up to 2 lbs. in weight. From 35 to 40 calves are yearly brought into the dairy, and about the same number are fatted; in other words, the number of calves reared is, as nearly as possible, equally divided between males and females, the males predominating, and these as a rule are converted into steers. The cows are almost all Jydsk, or Jutland cows, and the best of them give about 41 lbs. of milk per day, or 16 quarts. At their best they average 30 lbs., while, taking the yield in the ordinary way, it seldom exceeds 15 lbs., a quantity which, although it might be better, cannot fairly be called small, considering that the cattle themselves are really a small race. In spring they get wheat bran in the morning; in summer their food is entirely grass, whereas in winter the first feed at 5 o'clock in the morning includes straw and rape or palm-cake At 2 o'clock hay, followed by whole mangolds, nearly a bushel per cow, 4 to 5 lbs. of cake being given in two feeds morning and night. They also get straw the last thing at night.

On this farm the handbooks and forms of record prepared by Professor Segelcke are used by the students. Let us give an example from the book carried by the student to whom we have referred; and it may be added that these books are regularly checked by the head dairymaid, so that inaccuracy is almost impossible.

JUNE 23.

Cream. 400 lbs.	Milk. 2058 lbs.	Milking. Five o'clock.	Temperature of milk-room. 8° Réaumur.
Temperature in cream-tub 13° Réaumur.	Cooled down for churning to $9\frac{1}{2}$° Réaumur.	Raised for churning. 11 R.	Time in churning. 45 min.
Revolutions per minute. 160	Colouring added. $\frac{6}{100}$ lbs.	Salt added per lb. $\frac{4\frac{1}{2}}{100}$ lbs.	Lbs. milk per lb. butter. $26\frac{7}{10}$

Columns for every one of these particulars are provided in all the books; and the necessity of keeping strict records of the temperature of the cream is very important, as it is artificially soured, and that separated one day is left to sour for use in churning the next day. It will be noticed that colouring is added, and this is the case almost all through the country. The cowshed is a single, very long building, with a passage down the centre. Each cow-stall is 6 feet in width, and contains standing for two animals. There is the usual gutter at the back, which is regularly littered with dry earth or peat broken up into fragments. This answers two purposes: it absorbs the manure to a great extent, keeping the place much sweeter than under ordinary circumstances, and provides excellent manure for the land at a very small cost. The manger is of wood, cut into a convenient form, but placed upon the floor—a system which is common in some parts of England. There is a smaller one placed above, which is usually kept filled with water, a spout running right through it for the purpose of emptying or filling at will. Each

Fig. 167. A German Cheese-room.

cow is chained with a short chain, the ring of which is attached to an upright iron bar, so that it can slide from top to bottom, and enable the cow to stand or lie down at her ease. Overhead is a black tablet, with the name, age, and full particulars of every cow written upon it. The passage through the cowhouse is sufficiently wide and commodious for a cart to pass through with the food; but the house is decidedly low, although it is built so for the purpose of providing a hay-room overhead, this also adding considerably to the warmth of the animals in winter. At one end is a stall provided for the purpose of storing the peat used for littering the cows, and there is an admirable arrangement, by which, upon turning a crank, the whole of the apertures which are provided for the admission of air can be closed at once and opened in the same way. The calf-house is also a low-pitched building, and is divided into twelve pens, which are some 4 yards by 2½ yards in extent, two calves being in each. Here they are fatted until they reach the age of about 18 months, when they are sold. The racks and mangers for food are in the passage, so that they are provided with great ease. Every place is well drained, and the passage itself is invariably sanded. The winter calves are kept here throughout the entire summer, but the heifers and other calves were all out at grass. The students themselves are induced to take an interest in the work by being allotted a certain number of cows, and there is a sort of rivalry between them, each one endeavouring, as far as possible, to show a better result from his charges than his neighbours. The cows are really under the charge of one man, and the horses under another, but in the winter each department has an additional man to attend to it. There are six hired girls on the farm, three of whom are in the dairy, two being assistants to the chief dairymaid, the others assisting the housekeeper, and some of them also milking, being assisted in this by the students. The centrifugal machine is managed by the dairymaid, but the steam-engine has a student for its fireman. During harvest the principal part of the work is

done by the students, who work the reaping-machines to perfection. In the house there are two tables, and those students who dine at Mr. Branth's table pay a small sum—some £33 a year —while the others, who do the principal portion of the work, pay nothing; but all are fed upon the same food.

We may here give an example of the work of a Sleswig farm, occupied by Herr Fausbol, who is now a German, though much against his will, infinitely preferring the old Danish *régime* to the rule which imposes such heavy taxes as to swamp almost his entire profits. Herr Fausbol farms 180 acres, and keeps 150 head of stock, of which 40 are dairy cows, and 30 heifers intended for the dairy. These animals are of the race of the country, crossed with Shorthorns, and they average about 30 lbs. or 12 quarts of milk daily. In summer they get nothing but grass; but in winter they receive 4 lbs. of bran, 2 lbs. of barley-meal, and 1 lb. of rape-cake per day; the last-named giving the milk a nice flavour. Herr Fausbol has tried both linseed-cake and palm-nut meal, but objects to both for the production of milk. The cattle receive as much hay and straw as they will consume, although rye is the principal crop of the district. In the dairy the milk is skimmed at twelve and twenty-four hours, and the cream is not churned until it has been soured. He obtains 3 per cent. of butter in summer and 3½ per cent. in winter, which is not much better than is obtained in Holland. The skim-milk is consumed by calves and pigs, the latter alone getting the buttermilk. In this district good cows realise £25 each, and when used up they are fatted and sent into Hamburg. Herr Fausbol was quite of opinion that the system of Sleswig was much inferior to that adopted in England, and he was most anxious that his young daughter should be sent to this country to learn to become a first-class dairymaid.

Although the dairy system is rapidly advancing in Germany, and notwithstanding the fact that some of the most profound of agricultural scholars, such as Fleischmann and Soxhlet, who have

given much attention to the dairy, are Germans, the Fatherland is not as yet very famous for any particular cheese, whereas as a butter-making country of high rank it is quite out of the question. It is true that in some of the southern provinces a few rich cheeses are made, but these, if not exactly French, are manufactured after a French model, while the pungent skim-milk cheeses of the north are equally common in Belgium and the north of France. Germany, however, is becoming more famous than any other European country for the modern factory system, which is spreading through its northern provinces.

The following remarks will give some idea of the organisation of factories in Southern Germany, as well as in some parts of France and Switzerland. According to M. Chevron, one of the ablest of agricultural scientists, the majority of these societies are controlled by a committee of direction of five members, and a committee of surveillance of nine members, who are elected by the general body. The first-named committee draws up the rules relating to the conduct of the business, and to these the members are required to submit. The two committees meet once a quarter to deliberate, and combined, they form the council of administration. The members of the society are required to send the whole of their milk to the factory, deducting only what is required for home use and the feeding of their calves, a fine of 150 marks being inflicted when this rule is broken. Every member informs the society at the beginning of each year of the number of cows from which he will send in his milk. At the Society of Mulhouse, for instance, every five cows are expected to furnish from 20 to 50 litres of milk per day, but as the yield may vary still more widely, there is a *tolérance* of 6 per cent. above and 20 per cent. below these figures.

As a rule the milk from sick cows must not be delivered, although the Society of Mulhouse accepts the milk from cows suffering from foot-and-mouth disease at a reduced price, but it is not used for consumption in its ordinary state. A member is required

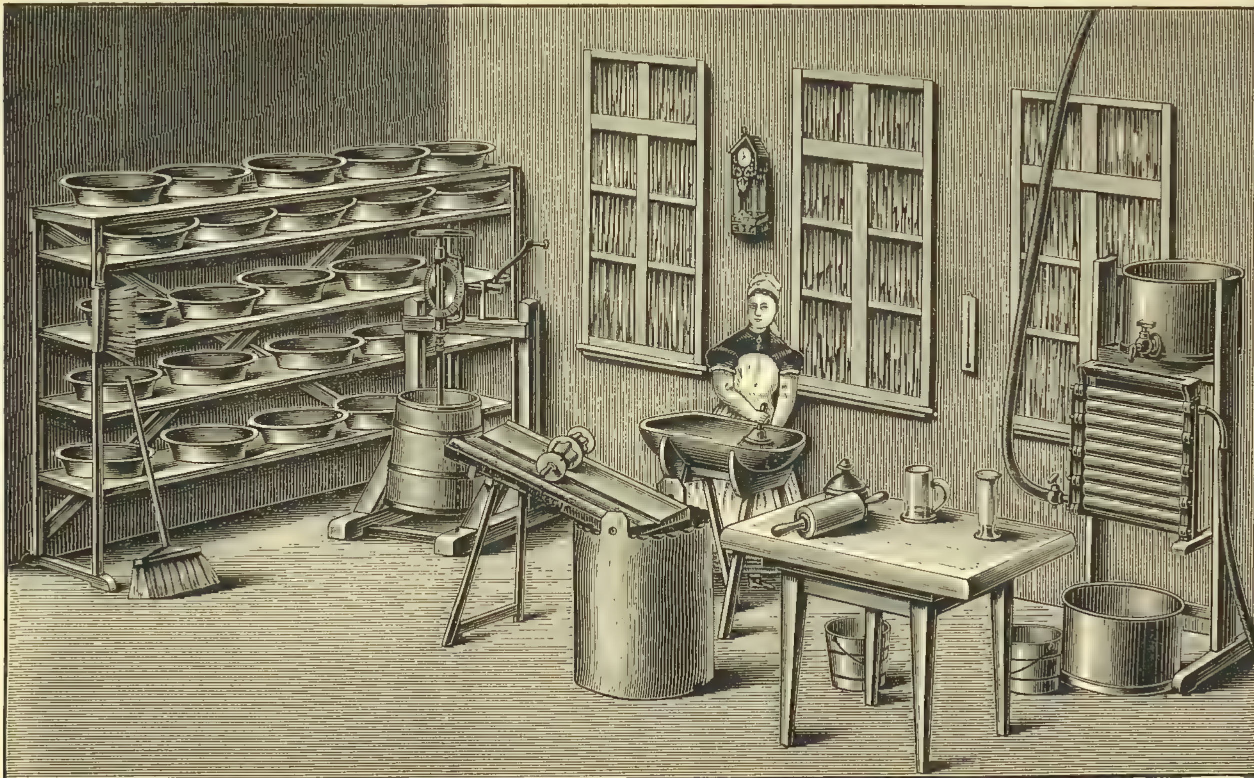


Fig. 168. A Holstein Dairy.

to inform the direction when he has an attack of disease among his cattle, under penalty of a fine. Some societies decline to accept milk within five days after the calving of a cow, and, in addition, they require that for fifteen days further, this milk shall be sent in in a special vessel. The rules with regard to milking hours are generally fixed, and they are from 6 to 7 in the morning and from 5 to 7 in the evening. Where, however, there are three milkings per day, these are fixed from 1st April to 1st October, from 6 to 7 in the morning, 11.30 to 2.30 in the day, and 6.30 to 7.30 in the evening, and, for the rest of the year, 6.30 to 8 in the morning, 11.30 to 2.30 in the day, and 6 to 7 in the evening. If milk arrives late at the factory, it is accepted if it does not interfere with the ordinary work, otherwise a small fine is imposed. All milk sent out for retailing is enclosed in a lock-up van, the milk-man being thus unable to adulterate the milk. That despatched by the farmer is also locked, one key remaining with him, the other being left at the factory. The milk is invariably weighed. In some cases the rules provide for the proper feeding of the cows, the mode of transport, the necessity for washing the udder of the cow, and for the proper cleaning of the milk-cans.

There are several rules which are wonderfully strict with regard to the purity of the milk supplied, these requiring a certain percentage of cream—usually 10. At the Society of Mulhouse (of which there are nearly 200 members who supply milk) the rules require that the milk shall be examined every fortnight, the day of the visit of the inspector being kept secret. When an adulterated sample is discovered, the committee of direction appoint a member to repeat the analysis, and in addition to the refusal of all adulterated milk, the member supplying it is fined 300 marks and brought before the general body of members, who generally pronounce his expulsion from the society. Where a society fixes a minimum cream yield it is found necessary to guard against the reduction of the quality of richer milk by the addition of water or by skimming, and to prevent this fraud, inspectors are

occasionally sent to the farms to see the cows milked, to take samples of the milk, and to compare them with that sent to the factory; members opposing this course being fined in the sum of 75 marks. In some societies the capital is subscribed by the members at the rate of 100 marks for every five cows, or fraction of five; in other words, at the rate of £1 per cow, and upon this sum they receive interest at 6 per cent.

M. Chevron estimates that the amount of capital required in a factory dealing with from 1000 to 1500 litres of milk (220 to 330 gallons) per day, for the purpose of converting the milk into butter and cheese, is 7500 fr., or £300. If, however, the skim-milk is not made into cheese but sold in its natural state, £50 may be deducted from this sum, and £130 added for the cost of implements used in the manufacture and transport of the milk.

THE END.

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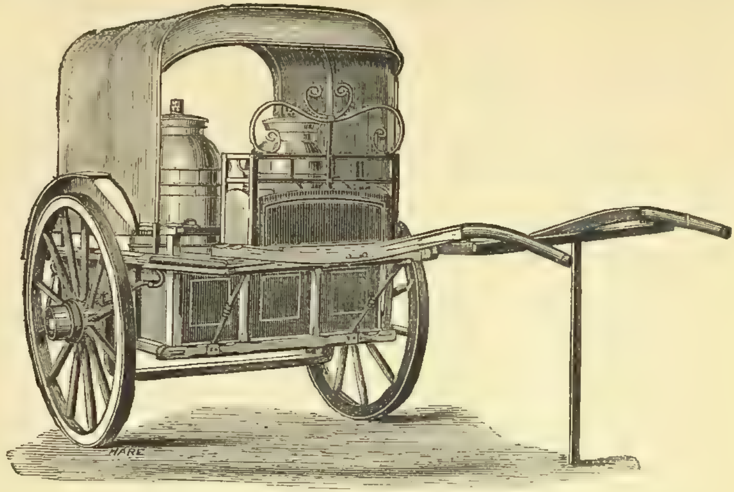

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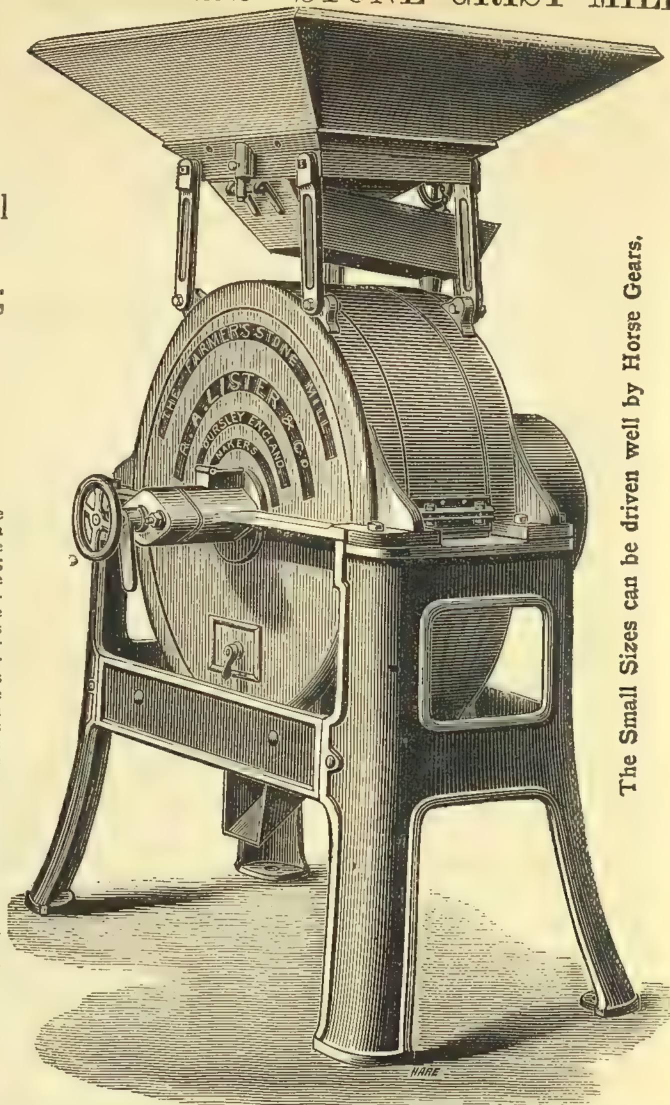

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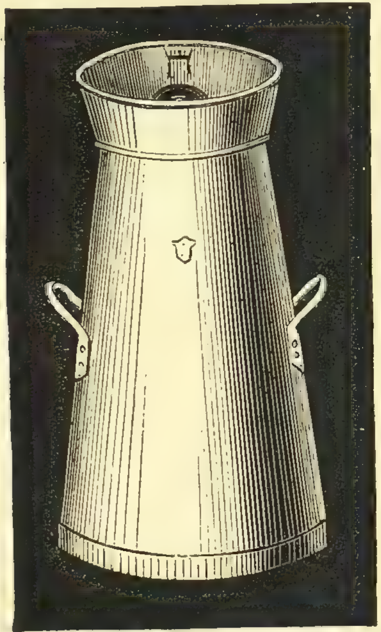

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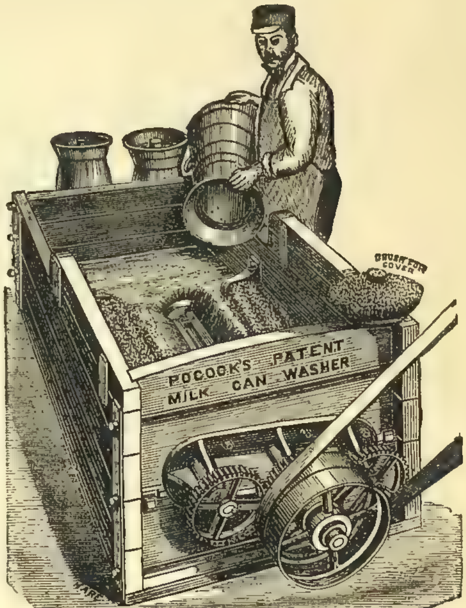

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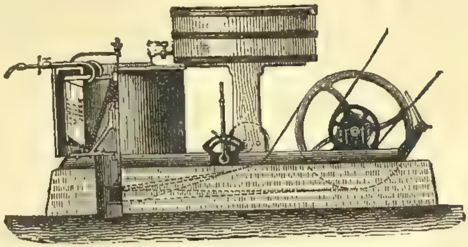

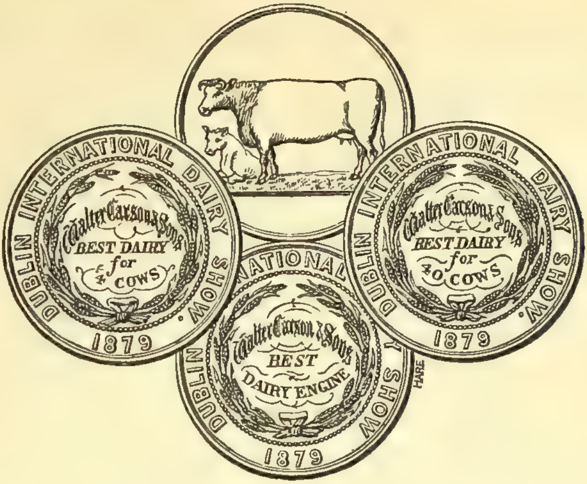

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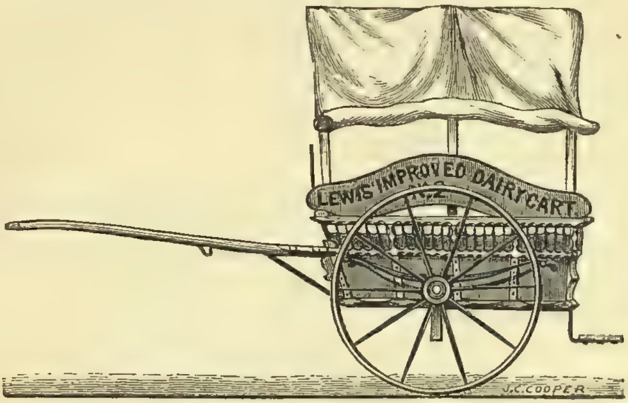

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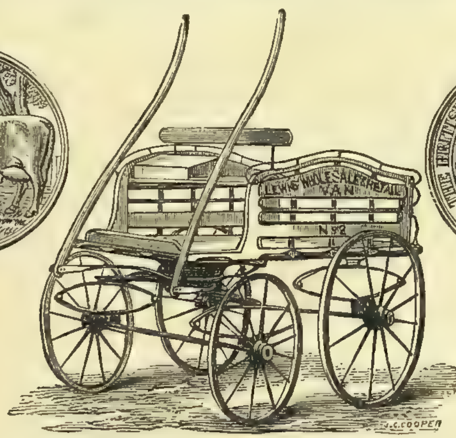

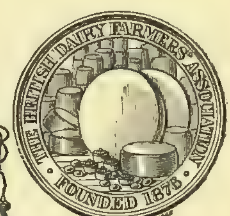

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